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Microfiche Set of Documents Announced in

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Volume 9, Number 1

1976

The Center for Vocational Education
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INTRODUCTION

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ABSTRACT: THE PURPOSE OF THIS INSTRUCTOR'S GUIDE IS TO PRESENT SUGGESTED ACTIVITIES USEFUL DURING THE EXPLORATION LEVEL OF A PROGRAM IN CONSTRUCTION FOR GRADES 9-12. THE EXPLORATION PROGRAM IS INTENDED TO OFFER THE STUDENT A NUMBER OF EXPERIENCES AND SPECIFIC CAREER INFORMATION CONCERNING THE FIELD OF CONSTRUCTION. GIVEN PROPER WORK EXPERIENCES, SUPPORTED BY OCCUPATIONAL AND CAREER INFORMATION, THE STUDENT MAY DECIDE EITHER TO GO ON TO A CHOSEN PREPARATION CLASS IN CONSTRUCTION OR TO EXPLORE ADDITIONAL CAREER AREAS IN A FIELD OTHER THAN CONSTRUCTION. STUDENTS SHOULD BE GIVEN EVERY OPPORTUNITY TO WORK WITH REAL TOOLS AND THE ACTUAL MATERIALS USED IN CONSTRUCTION. THIS GUIDE INTRODUCES THE TOPICS OF THE SIX PREPARATION-LEVEL GUIDES IN THE SERIES (WOOD; FINISHING; ENGINEERING, SUPPORT AND MANAGEMENT SERVICES; METAL; ELECTRICITY; AND MASONRY), AND ALSO INCLUDES A UNIT DEALING WITH HEAVY EQUIPMENT. EACH OF THE UNITS HAS AN OVERALL OBJECTIVE AND SOURCES OF INFORMATION. SUBOBJECTIVES FOLLOW, EACH WITH SUGGESTED ACTIVITIES. APPENDED ARE A SUGGESTED TOOL AND EQUIPMENT LIST FOR EXPLORATION CLASSES AND A SAMPLE LESSON PLAN. THIS DOCUMENT SHOULD BE USED IN CONJUNCTION WITH THE STUDENT MANUAL FOR CAREERS IN CONSTRUCTION (VT 102 406 IN THIS ISSUE). (AUTHOR/LJ)

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CAREERS IN CONSTRUCTION

construction industry series
instructor's guide
exploration level

VT 102 405

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AUSTIN, TEXAS
1975

This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

EXPLORATION LEVEL:

Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

OCCUPATIONAL PREPARATION LEVEL:

Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
Metal - Student Manual
Metal - Instructor's Guide
Electricity - Student Manual
Electricity - Instructor's Guide
Masonry - Student Manual
Masonry - Instructor's Guide

In addition, there is an Articulation Guide designed for these instructional materials in construction.

Articulation Guide - Construction Industry Series

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INTRODUCTION TO INSTRUCTOR'S GUIDE

PURPOSE OF PROGRAM

The purpose of the exploration program is to offer the student a number of experiences and specific career information concerning the field of construction. Given proper work experiences, supported by occupational and career information, the student may decide either to go on to a chosen preparation class in construction or to explore additional career areas in a field other than construction.

To make the exploration experience as realistic as possible, students should be given every opportunity to work with real tools and the actual materials used in construction. You should not expect them to become completely competent in the use of these tools, but they should explore the processes of construction rather than stressing the sights, sounds, feels and smells of real work on the construction site.

A student needs much more than just the feel of an occupation to make realistic career decisions. Students need information about all aspects of the occupation being considered, including employment opportunities, requisite training, working conditions, personal and physical requirements and other criteria. The instructor, from previous experiences, should be prepared to answer most of these questions. Supplementary address lists in the program guides should provide additional guidance in answering student questions.

The student, equipped with these experiences and information, should be able to accomplish the overall objective of the exploratory program, making a realistic evaluation of the construction industry. Using this evaluation, the student must also estimate the potential in this field and be ready to make some informed career decisions and planning to achieve those goals.

PROGRAM APPROACH AND TECHNIQUE

The Instructor Guides and a description of the four-step method of teaching are used to organize and present this program.

Four-Step Method

Step 1 Preparing the students. Introduce and explain the topic or subject to be covered in a particular lesson. This step may be presented the day before the lesson to develop student curiosity and interest. An assigned reading in the Student Resource Manual would be appropriate at this time.

Step 2 Presenting the lesson. The lesson should be presented using a variety of teaching techniques and aids, if practical. It is highly recommended that resource people from industry, or preparation level students, be used to assist your presentation.

Step 3 Student application. The students now become involved by doing the planned activity. This step is most important because of the hands-on involvement by the students.

Step 4 Follow-up. The exploration experience should now be recapped with a presentation and discussion of the career opportunities within the related area.

(See Appendix 2, Sample Lesson Plan.)

EXPLORATORY LEVEL

During the exploratory level, the primary concern of the instructor will be to present realistic experiences which can be used by the student in making career decisions. Hands-on activities actually explore construction with the practices common to the various occupations presented. The instructor may rely heavily on field trips and the use of resource people from industry.

Instructor's Guide

The Instructor's Guide contains suggested activities which can be used by an instructor during the exploratory level of the construction program. Individual teaching situations will require necessary program modifications. The exploratory guide can serve as a base upon which a practical exploratory program in construction can be built.

Student Resource Manual

The Student Resource Manual provides additional information to a student whose exploratory activities have given a tentative career direction in construction. Interested students should read the Student Resource Manual and discuss it with family, friends, counselors and teachers. The Student Resource Manual is designed to serve as a supplement to available guidance services and is an introduction to construction careers.

The Student Resource Manual contains general information about the career field, as well as specific information about the occupational families within that field. The unit on Electricity, for example, shows the career field of electricity in general terms and then considers the related occupational families -- construction electrician, maintenance electrician, electrical draftsman, electrical engineer and occupations related to the transmission and distribution of electricity.

Working conditions, training requirements, opportunities for advancement and the future outlook of the field are all included. The final section of the manual lists a variety of places the student can write or visit to find additional information.

BEHAVIORAL OBJECTIVES

The Instructor Guides are structured around behavioral objectives. The applications of behavioral objectives in the exploration sequence are not as strict as they will be for the preparation classes, since the purpose of the exploratory course is quite different than that of the preparation programs.

In exploration, the student is exposed to several different construction areas for the purpose of selecting an area of future study. One of the basic elements of behavioral objectives cannot be served -- rating a student's ability to perform at a predetermined skill level. If a student chooses not to enter a preparation class in construction, this could hardly be taken as a failure.

The exploratory program is divided into several blocks which represent different experiences in construction. Each instructional block contains an overall objective and sources of information. The use of a modified form of behavioral objective, lists systematically, exploratory tasks for the student. Behavioral objectives are directed towards student performance. It programs student exploratory activities and experiences.

Instructors of construction occupations should study the basic wording and structure of the suggested student activities. Individual teaching situations may require certain modifications and revisions. The intent of this guide is to offer instructional suggestions and informational sources to structure an exploratory program around the needs of students and the community.

INTRODUCTORY OUTLINE

This is a suggested outline which could be used to introduce each specific field in construction, and as a check list by instructors to assure maximum exploratory experiences.

I. Purpose of the Course

- A. Provide exposure to and use of basic tools, equipment and materials for each specific field of construction.
- B. Familiarize students with working environment of each specific field of construction.
- C. Provide experiences and information for tentative career decisions through the exploration process.
- D. Establish a realistic and working relationship between academic and vocational-technical education.

II. General Safety

- A. Identify common hazards and preventions.
- B. Formulate first aid, accident and evacuation procedures.

III. Use of Student Resource Manual

IV. Discuss career options available in each specific field of construction

A. Trade and technical areas
B. Professional areas
C. Supply and distribution services
D. Public utilities
E. Armed services
F. Merchant service
G. Inspection and safety areas

V. Trace specific product and material distribution from manufacturer to building site

CONSTRUCTION OCCUPATIONS AND CAREER EDUCATION

THE WORLD OF WORK

Work responds to something profound and basic in human nature. It plays a pervasive and powerful role in the psychological, social and economic aspects of our lives. It is a central institution and influences other basic institutions -- family, community, schools and others.

The economic importance of work is obvious and is the means by which we provide the goods and services needed and desired by ourselves and our society. Through the economic rewards of work, we provide essentials for living, we satisfy many of transient wants and we provide for our futures. For most of the history of mankind, and for a large part of humanity today, the economic meaning of work is most important.

The economic and societal importance of work is to produce and distribute goods and services and to transform natural resources to satisfy needs and desires. Far less attention has been paid to the personal meaning of work, yet it is clear that work plays a very important psychological role in the formation of self-esteem, identity and a sense of order.

PREPARING STUDENTS FOR WORK

Since work is important, and most people spend the majority of their adult lives in work-related activities, educators should take an interest in the conditions, activities, rewards and requirements of the world outside of school.

Vocational education has been pushed into the background for too long, and it has suffered from shortsightedness. Career Education, and the new information that has come to light on work and the worker, has helped to expand and realign the goals of vocational education; to improve the approaches taken towards implementing these expanded goals; to bring vocational education out into the open and into a harmonious relationship with academic curricula.

Career Education seeks to expand the goals of traditional vocational education. It seeks to ensure that students receive broader training. It realizes that not all students have understanding of the labor market, so it helps to inform students about the wide range of occupational possibilities. There is no intent to persuade them in their choices, only to offer them as much information and experiences as possible about the world of work. In this way they should be able to make much more informed career choices.

Career Education seeks to remind students that mid-career changes are also possible. Schools must realize that it is impossible to provide every student with the precise skills which will be in demand upon graduation. What Career Education can do, is offer students some training in the high-frequency operations of their selected career field. These operations should be largely exempt from immediate technological change. More advanced skills may be acquired on the job, in apprenticeship programs or through industrial training programs.

IMPROVING INSTRUCTIONAL APPROACHES

Career Education should help to improve instructional approaches. It recognizes that for preparation training to be valid, situations must be as realistic as possible. The student should know what it feels like to be a welder; to experience working in hot, poorly ventilated rooms and in cramped, uncomfortable positions.

Career Education also seeks to re-establish relations between vocational education teachers and the academic community. It should inject reality into the academic curriculum. It must no longer be stressed that students master the intricacies to set theory and understand the workings of abstract logic, before learning to balance their checkbooks.

Career educators are seeking to ensure that students get at least the salable academic skills they will need to compete in the marketplace -- skills as reading, speaking, adding, subtracting, multiplying and dividing, computing areas, keeping records, etc. Academic instructors should be invited to vocational classrooms for special sessions, so that applications used in vocational classes can be reinforced in the academic classroom.

DEFINITION OF CAREER EDUCATION

Career Education is a total and comprehensive concept approach to education. It seeks to start the process of bringing students into the world of work. It gives exposure to occupational information in English, social science, geography, science, arithmetic and other classes, so that students may have a better idea as to what to do upon leaving public education. It seeks to offer guidance and re-training, facilitating the educational process throughout the individual's productive life.

Career Education seeks to expand the goals of vocational education into a total skills package -- all the skills that are necessary to select, find, obtain and keep a job. It must be flexible and recognize the importance of the student, realizing that only the student can decide on a career. Defining a student as any person involved in the educational system, it assumes that there are no dropouts, only individuals who choose to go to work or pursue a different kind of education. To facilitate this process, entrance and exit requirements must be flexible enough to enable all persons to acquire the educational and occupational experiences that meet their own individual needs.

WOOD

WOOD

OVERALL OBJECTIVE: The student will determine ability to construct, erect, plumb and brace a 10 foot section of 24" concrete forming using 2" pine stock.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builder 3 & 2, (United States Navy, NAVPERS 10648-F, 1970). GPO #D208.11:B68/3/970.

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co.: 123 West Taft Drive, South Holland, Illinois 60473), 1973.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Computing cubic measurements
- Scale measurements

Science

- Pressure of enclosed fluids

Communication Skills

- Occupational Outlook Handbook
- Blueprint reading basics
- Development of working drawings

WOOD

CONTENT TITLE: Concrete Forming

SUB OBJECTIVE 1: Plumb and erect form stakes.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates plumbing and erecting form stakes.

A. Stretch string line between pre-erected batter boards.
B. Drive stakes 1-1/2" outside of line, 24" o.c. along form length.
C. Check plumb of stakes during and after driving.
D. Complete driving stakes by driving to the grade line.
E. Drive end stakes one half of their width beyond end, for attaching successive form boards.
F. Check diagonal measurement for square.

II. Students erect and plumb form stakes.

WOOD

CONTENT TITLE: Concrete Forming

SUB OBJECTIVE 2: Install the form lumber, bracing and kick stakes to finish a concrete form adequately strong to support the concrete during curing, and with sufficient skill to enable easy removal of the form after curing.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates attaching form lumber to the form stakes.

A. Place top board on inside of form stakes level with plumb line.
B. Attach form lumber to stake, nailing from inside.
C. Position lower form board and install.

II. Instructor demonstrates bracing and installing kicker stakes.

A. Attach braces from the form top at each inserted form stake.
B. Drive in kicker stakes.
C. Recheck form for alignment and plumb.
D. Affix lower end of brace to kicker stake.

III. Students attach form lumber to the form stakes and install bracing and kicker stakes.

A. Place top board on inside of form stakes level with plumb line.
B. Attach form lumber to stake, nailing from inside.
C. Position lower form board and install.
D. Attach braces from the form top at each inserted form stake.
E. Drive kicker stakes.
F. Recheck form for alignment and plumb.
G. Affix lower end of brace to kicker stake.

WOOD

OVERALL OBJECTIVE: The student will determine ability to lay diagonal 1 x 6 subflooring for a frame house.

SOURCES OF INFORMATION

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Schmidt, John L. et.al., Construction - Principles, Materials and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1973.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co.: 123 West Taft Drive, South Holland, Illinois 60473), 1973.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Angles
- Plumb
- Square
- Level

Communication Skills

- Related safety information (use and care of electrical tools and equipment)
- Student Resource Manual
- Occupational Outlook Handbook
- Occupational briefs

WOOD

CONTENT TITLE: Safety

SUB OBJECTIVE 3: The student will demonstrate adequate safety consciousness in using the portable saw.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor identifies the hazards of portable saw operation and stresses correct handling procedures.

   A. Check blade for sharpness.
   B. Check guard for proper operation.
   C. Wear safety goggles.
   D. Connect saw to power with proper cord size and with proper grounding.
   E. Cut plywood and 2 x 4's avoiding stalling, binding, etc.
   F. Store tools and equipment after use.

II. Students use a portable saw, demonstrating safety awareness.

CONTENT TITLE: Flooring

SUB OBJECTIVE 4: Lay out and lay portions of a diagonal subfloor, without splices.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and laying a subfloor.

A. Measure and mark a point on each side four feet from the corner.
B. Snap a chalk line across these points.
C. Nail preliminary board on chalk mark leaving an overhang on the sill of each end.
D. Start nailing succeeding boards toward center of house.

II. Students lay out and lay subflooring.

CONTENT TITLE: Flooring

SUB OBJECTIVE 5: Splice floor materials over a floor joist.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates techniques of floor splicing.

A. Select longest stock on hand.
B. Determine location of splice.
C. Scribe a 45° line on the board on center, above joist.
D. Cut the board on the mark and attach to splice joist.
E. Mark and cut a 45° complementary angle on another piece of stock.
F. Attach the second board, with cut over splice joist, to the joist, 1/8" from first.

II. Students splice subfloor stock.

WOOD

CONTENT TITLE: Flooring

SUB OBJECTIVE 6: Trim excess flooring material.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates trimming excess material.

A. Position nails for a chalk line.
B. Strike chalk line even with edge of sill.
C. Trim excess material using a portable saw.

II. Students trim excess subflooring from edge of sill.

WOOD

OVERALL OBJECTIVE: The student will determine ability to lay out, cut material, and frame an exterior wall section that will have one door and one window.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builder 3 & 2, (United States Navy, NAVPERS 10648-F, 1970). GPO #D208.11:B68/3/970.

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Muller, Edward J., Architectural Drafting, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1967.

Schmidt, John L. et.al., Construction - Principles, Materials and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1972.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co.: 123 West Taft Drive, South Holland, Illinois 60473), 1973.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole Numbers
  - Fractions
- Sizing
  - Lumber
  - Nails

Communication Skills

- Occupational and career information
  - Dictionary of Occupational Titles
  - Occupational Outlook Handbook
  - Occupational briefs
- Related safety information (use and care of electrical tools and equipment)
- Student Resource Manual
- Newspaper Want Ads for Carpenters

WOOD

CONTENT TITLE: Framing

SUB OBJECTIVE 7: Lay out and center mark plates.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out center marks for studs on plates.

   A. Refer to job sheet for measurements.
   B. Locate stud positions and mark one plate.
   C. Demonstrate marking both plates with tri-square or framing square.
   D. Indicate stud positions with an "x" mark.

II. Students lay out center marks for studs on plates.

WOOD

CONTENT TITLE: Framing

SUB OBJECTIVE 8: Place and attach precut studs to top plate.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates nailing precut studs to top plate.

A. Discuss nail selection and sizing.
B. Demonstrate nailing positions and procedures.
C. Demonstrate techniques of supporting members while nailing.

II. Students attach precut studs to top plate.

A. Select proper nails.
B. Lay out support members to be nailed
C. Nail studs to top plate.

CONTENT TITLE: Framing

SUB OBJECTIVE 9: Construct corner studs from precut stud stock.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the construction of a corner stud.

A. Refer to blueprint for details of construction.
B. Discuss function of a corner stud.
C. Demonstrate nailing studs with correct spaces.
D. Demonstrate positioning of third member to make the inside corner.

II. Students fabricate a corner stud from precut stock.

A. Check blueprints for details of construction.
B. Nail studs in place with correct spaces and demonstrating correct nailing procedures.
C. Position third member to make inside corner.

WOOD

CONTENT TITLE: Framing

SUB OBJECTIVE 10: Working in teams, the students will raise a wall section and install it in the correct position, accurately aligned to the vertical.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses raising and installing the wall section.

A. Discuss safety procedures.
B. Outline team operations.
C. Demonstrate holding and toenailing an erected wall section into place.

II. Students raise a wall section.

A. Working in teams of at least four, lift the top side of the wall frame, and walk it into an upright position.
B. Locate stud layout marks, and while others hold wall upright, toenail the studs into position.

CONTENT TITLE: Framing

SUB OBJECTIVE 11: Plumb and brace an erected butt unattached wall section in both directions.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates plumbing the section.

A. Nail a temporary 2 x 4 brace near the top of both outside studs of the section.
B. Plumb the section and hold in place.
C. Nail lower end of each temporary brace to an available sole plate or a block that is nailed to the floor.
D. Recheck for plumb and adjust if necessary.
E. Plumb section laterally, checking at several frame points.
F. Nail in permanent braces according to the blueprint.

II. Students plumb and brace the section in both directions.

WOOD

OVERALL OBJECTIVE: The student will determine ability to lay out, measure, cut and install interior casing on a pre-hung door.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builder 3 & 2, (United States Navy, NAVPERS 10648-F, 1970). GPO #D208.11:B68/3/970.

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co.: 123 West Taft Drive, South Holland, Illinois 60743), 1973.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Plumb
- Level
- Measurements
- Angles

Communication Skills

- Occupational Outlook Handbook
- Want Ads for finish carpenters
- Apprenticeship information
- Manufacturer's literature

WOOD

CONTENT TITLE: Trim

SUB OBJECTIVE 12: Lay out and install a door frame.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and installing a door frame.

A. Check length of head and side jambs to ensure that they are correct. Correct as necessary.
B. Assemble frame using 8d nails.
C. Place frame in opening with side jambs resting on finish floor or spacer blocks if floor has not been installed.
D. Trim side jambs as necessary to level head jamb.
E. Measure and cut a spreader and position between side jambs at floor level.
F. Scribe a line on each side jamb. Line should be width of door plus 7/8" from door side of jamb.
G. Center frame in opening and wedge into place using double shingle wedges. Stud side of wedges may be nailed into place first. Wedges should be used top, bottom, and middle of each side jamb.
H. Plumb the jambs, adjusting shingles as necessary until both side are plumb.
I. Nail jambs into place using 8d casing nails. Use double, staggered nails about 1/2" on either side of line scribed in step F. Check plumb regularly and adjust as necessary.
J. Add extra blocking at latch level and other levels as desired. Check plumb regularly.

II. Students lay out and install a door frame.

WOOD

CONTENT TITLE: Trim

SUB OBJECTIVE 13: Lay out a door stop.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out a door stop.

A. Measure from floor to head jamb adding 1/4" to measurement.
B. Measure width of head jamb, adding 1/2" to measurement.
C. Transfer measurement of height to beveled edge of trim stock.
D. Scribe a 45° line upward from height mark and beveled edge.
E. Transfer head jamb measurements to the beveled edges of trim stock.
F. Scribe a 45° line outward from marks on beveled edge.

II. Students measure and lay out a door casing.

CONTENT TITLE: Trim

SUB OBJECTIVE 14: Install a door stop and door casing.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installation of a door casing.

A. Demonstrate use of mitre box and installation of trim.
B. Sand and cut edges.
C. Demonstrate finish nailing procedures.
D. Caulk and putty.

II. Students install a door casing and door stops.

A. Cut trim on correct line side.
B. Sand cut edges.
C. Position and attach stop pieces with finishing nails.
D. Position vertical casing in place, 1/4" from jamb.
E. Attach casing to jamb and stud with finishing nails.
F. Install opposite vertical casing similarly.
G. Install upper casing as above. Seams should be neat and unobtrusive.

WOOD

OVERALL OBJECTIVE: The student will determine ability to dry in a roof with 30 pound felt, and to apply asphalt shingles to a dried-in roof to form a leak-free roof.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builder 3 & 2, (United States Navy, NAVPERS 10648-F, 1970), GPO #D208.11:B68/3/970.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co.: 123 West Taft Drive, South Holland, Illinois 60473), 1973.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Computing square feet
- Estimating materials

Science

- Effects of moisture

Communication Skills

- Manufacturer's literature
- Related safety information (roofing hazards)
- Student Resource Manual
- Occupational Outlook Handbook
- Occupational briefs
- Review career opportunities available in wood

WOOD

CONTENT TITLE: Roofing

SUB OBJECTIVE 15: Dry in a roof with 30 pound felt.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates and discusses safety considerations.

   A. Discuss ladder safety.
   B. Discuss problems of material handling.
   C. Demonstrate walking on a slanted roof.

II. Instructor demonstrates applying rolled roofing felt.

   A. Demonstrate nail handling and nailing procedures for roofing applications.
   B. Roll out felt flush with eve edge of roof and cut for length.
   C. Attach upper edge first, followed by mid section and finally, lower edge.
   D. Roll and cut succeeding courses and attach.

III. Students dry in a roof deck.

   A. Lay out felt on eve edge.
   B. Attach, working from upper edge to lower edge.
   C. Roll and cut succeeding courses, attaching with correct overlap.

WOOD

CONTENT TITLE: Roofing

SUB OBJECTIVE 16: Determine center line of a roof, and lay the first course of shingles from that line.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates striking the center line.

A. With a tape measure, determine length of eave and its center.
B. Repeat for building ridge.
C. Strike chalk line from ridge to eave.

II. Instructor demonstrates applying starter course.

A. Holding shingle upside down, set butt flush with eave.
B. Align shingle edge with chalkline and attach to roof deck.
C. Nail succeeding shingles, edges contiguous until half the course is completed.

III. Students strike a center line and lay beginning course of shingles.

A. With a tape measure, determine length of eave, building ridge and centers of eave and ridge.
B. Strike chalk line from ridge to eave.
C. Holding shingle upside down, set butt flush with eave.
D. Align shingle edge with chalkline and attach to roof deck.
E. Nail succeeding shingles, edges contiguous until half the course is completed.
F. Repeat from center line in opposite direction until entire starter course is complete.

WOOD

CONTENT TITLE: Roofing

SUB OBJECTIVE 17: Lay all succeeding courses of shingles to form a leak-proof roof.

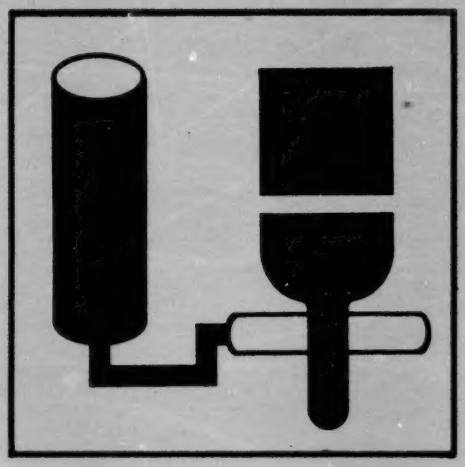
SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates application of successive shingle course.

A. Starting with a six inch offset over the center line, form a stagger joint.
B. Measure with a shingle hatchet a five inch up-grade (use indentation on shingle if available).
C. Check alignment with previous shingle.
D. Nail shingle down and attach succeeding shingles until course is completed.
E. Apply succeeding courses using principles of stagger and up-grade.
F. Make periodic (approximately every four feet) horizontal reference chalk lines.

II. Students apply asphalt shingles.

FINISHING



FINISHING

OVERALL OBJECTIVE: The student will insulate a standard, framed wall.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builder 3 & 2, (United States Navy, NAVPERS 10648-F, 1970), GPO #D208.11:B68/3/970.

Rogers, Tyler Steward, Thermal Design of Buildings, (John Wiley & Sons, Inc.: 605 Third Avenue, New York, New York 10016).

Schmidt, John L., et.al., Construction - Principles, Materials and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1972.

Wagner, Willis H., Modern Carpentry (Goodheart-Wilcox Co.: 123 West Taft Drive, South Holland, Illinois 60473), 1973.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Estimating
- Material Sizing

Science

- Insulation
  - Why insulate?
  - Qualities of insulation
- Vapor barriers

Communication Skills

- Student Resource Manual
- Manufacturer's literature
- Want Ads
- Dictionary of Occupational Titles
- Occupational Outlook Handbook
- Occupational briefs
- Related safety information

FINISHING

CONTENT TITLE: Insulating

SUB OBJECTIVE 1: Insulate the section against thermal loss, thermal absorption and vapor condensation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses aspects of non-structural insulating.

A. Discuss forms of fiberglass insulation such as blankets, batts, loose fills, etc.
B. Discuss reflective insulation and vapor barriers.
C. Discuss other special insulating materials such as vermiculite in concrete block, etc.

II. Instructor demonstrates insulating a typical wall section.

A. Compute quantity of insulating sheathing required.
B. Compute quantity of batting with reflective foil required.
C. Measure, cut and fasten exterior sheathing.
D. Measure, cut, form and fasten wool batting between wall studs.

III. Student insulates a typical wall section.

A. Compute quantity of materials required for the area.
B. Apply exterior sheathing.
C. Install batts between wall studs.

FINISHING

OVERALL OBJECTIVE: The student will determine ability to prepare old and new surfaces for painting and to apply smooth, even coats of paint to those surfaces.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builders 3 & 2, (United States Navy, NAVPERS 10648-F, 1970), GPO #D208.11:B68/3/970.

Hand, Jackson, How to Do Your Own Painting and Wallpapering, (Popular Science Publishing Co., Inc. (Harper & Row): 355 Lexington Avenue, New York, New York 10017), 1969.

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Schmidt, John L., et.al., Construction - Principles, Materials and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1972.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co.: 123 West Taft Drive, South Holland, Illinois 60473), 1973.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Computing square feet

Science

- Paints and protective coatings, pigmentation and vehicle surface preparation

Communication Skills

- Related safety information
  - Ladders and scaffolds
  - Paints and solvents
- Occupational Outlook Handbook
- Dictionary of Occupational Titles
- Student Resource Manual
- Newspaper want ads

FINISHING

CONTENT TITLE: Painting

SUB OBJECTIVE 2: Given an old, pre-painted surface, the student will adequately prepare the surface for application of fresh paint.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses aspects of surface preparation.

   A. Discuss safety considerations such as scaffolding, ventilation, protective clothing, electrical safety, safety belts and potential fire hazards.
   B. Discuss methods of paint removal, such as mechanical devices (scrapers, brushes, etc.) and chemical methods.

II. Instructor demonstrates preparation of an old surface for re-painting.

   A. Protect vulnerable areas from splatter.
   B. Set up ladders and/or scaffolding.
   C. Remove electrical plates and fixtures.
   D. Remove loose paint with a scraper.
   E. Fill cracks and holes with a filler.
   F. Allow time for filler to set; sand total area.
   G. Wipe area clean with general cleaning solvent.
   H. Clean all equipment.

III. Student prepares an old surface for fresh paint.

FINISHING

CONTENT TITLE: Painting

SUB OBJECTIVE 3: Apply a smooth and even coat of paint, oil base or latex, to that surface.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses various aspects of painting.

A. Discuss types of paint and their areas of application.
B. Discuss methods of application and the advantages of each.
C. Discuss the hazards and other physical characteristics (such as thinning and cleaning) of various paints.
D. Discuss the coverage capacity of various paints and methods of estimating paint needs.

II. Instructor demonstrates applying paint to the prepared surface with brush and rollers.

A. Compute quantity of paint required for area.
B. Protect floor, furniture, plantings, etc.
C. Erect scaffolding or ladders and discuss safety considerations for each.
D. Apply primer. (Mention drying times.)
E. Apply sealers. (Mention drying times.)
F. Apply paint in as many coats as necessary.
G. Clean up equipment and other materials.

III. Student applies paint to prepared surface using brushes and rollers.

A. Compute quantity of paint needed.
B. Prepare the area for painting, i.e., floor protection, removal of electrical fixtures, furniture, tools, masking, etc.
C. Determine type of sealer and/or primer required and apply.
D. Apply paint.
E. Apply second coat if needed.
F. Check for over-paint and splatter and remove if necessary.
G. Inspect work for defects, and remove protective drop cloths and tape.
H. Replace electrical plates and fixtures and remove ladders and scaffolding.
I. Clean tools and equipment.

FINISHING

OVERALL OBJECTIVE: The student will determine ability to prepare old and new surfaces for papering, and apply smooth layers of paper to those surfaces without conspicuous mismatching of pattern overlay, etc.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builders 3 & 2, (United States Navy, NAVPERS 10648-f, 1970), GPO #D208.11:B68/3/970.

Hand, Jackson, How to Do Your Own Painting and Wallpapering, (Popular Science Publishing Co., Inc. (Harper & Row): 355 Lexington Avenue, New York, New York 10017), 1969.

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Wall Covering, Painting and Decorating: A Course of Study, (Department of Industrial Education: College of Education, University of Missouri).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Computing costs/unit
- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Level and plumb

Science

- Adhesives
- Sizing Compounds
- Neutralizing agents

Communication Skills

- Manufacturer's literature
- Related safety--ladders and scaffolds
- Student Resource Manual
- Occupational Outlook Handbook
- Occupational briefs
- Newspaper want ads

FINISHING

CONTENT TITLE: Papering

SUB OBJECTIVE 4: Prepare a wall surface for papering.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing a wall surface for papering.

A. Protect floors and furniture.
B. Set up ladders and/or scaffolding.
C. Remove electrical plates and fixtures.
D. Remove old paper, loose paint, etc.
E. Fill cracks and holes.
F. Sand surface.
G. Seal "hot spots".
H. Clean surface.
I. Apply sizing.
J. Inspect preparation.
K. Clean tools and equipment.

II. Student prepares a wall surface for papering.

FINISHING

CONTENT TITLE: Papering

SUB OBJECTIVE 5: Estimate materials, measure and match designs, and apply a smooth even paper surface to a wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses application of wall covering materials.

   A. Discuss materials frequently used such as paper, cloth and vinyl.
   B. Discuss methods of matching designs, aligning and plumbing.

II. Instructor demonstrates papering a surface.

   A. Compute quantity of paper required for area.
   B. Protect floors and furniture.
   C. Mix adhesives (glue or paste).
   D. Measure and match designs.
   E. Cut sufficient quantity of paper.
   F. Determine starting point.
   G. Strike plumb line.
   H. Apply adhesive.
   I. Apply paper.
   J. Smooth out air pockets.
   K. Smooth out seams.
   L. Trim excess paper.
   M. Clean equipment and materials.

III. Student papers a wall.

   A. Place protective drop cloths.
   B. Measure wall and compute area and quantity of paper required.
   C. Mix adhesives.
   D. Cut first strip in excess for matching, and match and cut successive strips, stacking face down on work surface.
   E. Determine starting point.
   F. Strike plumb line.
   G. Apply adhesive.
   H. Apply fold strip to plumb line and smooth out air pockets.
   I. Apply successive strips, smooth seams and trim.
   J. Clean equipment and materials.

FINISHING

OVERALL OBJECTIVE: The student will determine ability to fit and install glazing in both metal and wooden frames and repair broken panes in old windows.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builder 3 & 2, (United States Navy, NAVPERS 10648-F, 1970), GPO #D208.11:B68/3/970.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material sizing

Science

- Modern Types and uses of glass in home and industry

Communication Skills

- Related safety--handling glass
- Occupational Outlook Handbook
- Student Resource Manual
- Apprenticeship information
- Newspaper want ads

FINISHING

CONTENT TITLE: Glazing

SUB OBJECTIVE 6: Measure, cut and fit glass for installation in a new metal sash.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates glazing a new metal sash.

A. Measure opening.
B. Cut glass to correct size.
C. Clean frame with cleaning solvent.
D. Apply a "cushion" layer of glazing compound in frame.
E. Press glass into the cushion layer. Emphasize safety and proper handling procedures at this point.
F. Install retainer springs.
G. Apply exterior glazing compound.
H. Smooth compound to the correct level.

II. Student glazes a new metal sash.

FINISHING

CONTENT TITLE: Glazing

SUB OBJECTIVE 7: Measure, cut and fit glass to replace a broken pane in a wooden multi-panel sash.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the installation and maintenance of glass.

A. Discuss common varieties of glass, mentioning their characteristics and peculiarities involved in their installation.
B. Discuss methods of cutting, breaking and finishing glass.

II. Instructor demonstrates replacing broken panes.

A. Remove broken fragments of glass. Emphasize safety.
B. Remove old compound. Emphasize safety.
C. Clean frame.
D. Apply linseed oil.
E. Measure opening and determine required shape of cut.
F. Cut glass to correct shape and "undersize."
G. Replace glass and install points.
H. Apply glazing compound and smooth with putty knife.

II. Student replaces broken panes.

FINISHING

OVERALL OBJECTIVE: The student will determine ability to estimate and install floor tile.

SOURCES OF INFORMATION

Installation Manual: Resilient Floors, (Armstrong Cork Co., Lancaster, Pennsylvania.

Schmidt, John L., et.al., Construction - Principles, Materials and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1972.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co.: 123 West Taft Drive, South Holland, Illinois 60473), 1973.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Computing square feet
- Squaring and layout

Science

- Materials used in floor coverings
- Adhesives

Communication Skills

- Manufacturer's literature
- Occupational Outlook Handbook
- Student Resource Manual
- Occupational Briefs
- Newspaper want ads

CONTENT TITLE: Floor Covering

SUB OBJECTIVE 8: Determine the center point of a room, preparatory to installing floor tile.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates determining the center point of the room.

A. Explain why tile must be started at the center of a room.
B. Demonstrate measuring procedure and placing reference mark.
C. Demonstrate striking the chalk lines across marks.

II. Student measure the room, places center reference marks and strikes chalk lines.

A. Measure the width along one side of the room.
B. Divide the width in half to find the center of that side.
C. Measure and mark the center.
D. Repeat the procedure for the opposite side. Repeat again for remaining walls.
E. Strike chalk line across marks to establish center point.

CONTENT TITLE Floor Covering

SUB OBJECTIVE 9: Apply adhesive to the floor.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. The instructor will demonstrate applying adhesive.

A. Stress the use of manufacturer's recommended adhesives.
B. Demonstrate spreading adhesive with a notched trowel.
C. Emphasize that adhesive must be evenly applied.
D. Emphasize that adhesive must be given adequate time to dry (refer to manufacturer's specifications).

II. Student will apply adhesive.

FINISHING

CONTENT TITLE: Floor Covering

SUB OBJECTIVE 10: Neatly lay floor tiles set with cement.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates determining the number of full tiles that may be laid from the center point and determining the border tile sizes.

   A. Position tiles, without adhesives, along the length of the room, starting from the center mark.
   B. Adjust tile course until opposite borders are equal. Borders should be at least one half tile width.
   C. Repeat the process along the width of the room to determine size of remaining borders.
   D. Mark around center tile for course starting point.

II. Instructor demonstrates setting tile in adhesive and laying successive tiles along a course.

   A. Spread adhesive.
   B. Set first tile.
   C. Roll out the tile to ensure intimate contact.
   D. Set successive tiles; emphasize care in aligning.
   E. Cut border tiles to fit. Lay and roll out to edge of room.
   F. Let stand to allow cement to cure.

III. Students install floor tile.

FINISHING

OVERALL OBJECTIVE: Given the planning procedures, the criteria for tree choice, planting procedures and maintenance information, the student will determine ability to select the planting site, a tree to be planted, and to plant a tree on the school campus.

SOURCES OF INFORMATION

Better Homes and Gardens Landscape Planning, (Meredith Corporation: 1716 Locust Street, Des Moines, Iowa 50336).

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

A Planning Guide for Home Landscaping, Texas A & M University Bulletin B-980, College Station, Texas.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions

Science

- Trees, shrubbery and grasses

Communication Skills

- Student Resource Manual
- Occupational Outlook Handbook
- Newspaper want ads
- Working drawings

FINISHING

CONTENT TITLE: Landscaping

SUB OBJECTIVE 11: Plant a tree.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor provides necessary background information for tree planting.

   A. Discuss future campus landscaping plans.
   B. Discuss the planting seasons for evergreens and deciduous trees.
   C. Mention trees adaptable to the given environment.

II. Instructor demonstrates planting a tree.

   A. Select the tree.
   B. Excavate the site.
   C. Prepare the soil.
   D. Place the tree.
   E. Cover the root system.
   F. Apply the moisture and finish covering.
   G. Prop the tree.
   H. Bank the tree.

III. Students plant a tree.

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

OVERALL OBJECTIVE: Given a set of templates, the student will determine ability to generate dimensions and letter a floor plan using basic drafting instruments.

SOURCES OF INFORMATION

Muller, Edward F., Architectural Drawing and Light Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1967.

Schmidt, John L., et.al., Construction - Principles, Materials and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1972.

Waffle, Harvey W., Architectural Drawing, (Bruce Publishing Co.: 850 Third Avenue, New York, New York 10022), 1962.

Wyatt, William E., General Archtectural Drawing, (Chas. A. Bennett Co., Inc.: 809 West Detweiller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Scale measurements
- Square feet computations

Communication Skills

- Basic blueprint interpretation
- Student Resource Manual
- Occupational Outlook Handbook
- Junior and Senior College catalogs
- Newspaper want ads

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

CONTENT TITLE: Drafting Symbology

SUB OBJECTIVE 1: Given a list of architectural symbols and their definitions, correctly match the symbols with their definitions.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates use of specifications in the development of a floor plan, demonstrating the use of symbols for structural details, windows, doors, plumbing, supply pipe, ductwork, registers, and electrical.

II. Student matches components with their appropriate symbols.

CONTENT TITLE: Drafting

SUB OBJECTIVE 2: Draw a scale diagram using common drafting instruments.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates using common drafting equipment.

A. Sharpen mechanical pencils.
B. Draw horizontal, vertical, and angle lines.
C. Use templates to draw symbols.
D. Draw gothic letters and numbers.
E. Construct a scale drawing.

II. Students use common drafting instruments.

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

CONTENT TITLE: Drafting

SUB OBJECTIVE 3: Use templates to develop a floor plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates developing a floor plan.

A. Construct from poster board 1/4" = 1" scaled shapes four each typically sized, modular (4' x 8' multiples) bedrooms, kitchens, bathrooms, and living rooms.

B. Develop a floor plan by arranging templates to obtain a suitable fit.

C. Convert template arrangement into a floor plan using basic drafting equipment.

II. Student develops a floor plan.

A. Arrange supplied templates in various fashions to arrive at a suitable arrangement.

B. Convert template arrangement into a floor plan using basic drafting equipment.

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

CONTENT TITLE: Drafting

SUB OBJECTIVE 4: Dimension a floor plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates dimensioning a floor plan.

A. Identify necessary dimensions.
B. Demonstrate proper placing of dimensions.
C. Demonstrate techniques of arrow construction.
D. Demonstrate use of a lettering guide.

II. Student dimensions a floor plan.

A. Identify necessary dimensions.
B. Place dimensions.
C. Draw arrows and use lettering guide to label floor plan.

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

OVERALL OBJECTIVE: Given a surveyed area, the student will determine ability to generate a contour map and survey locate a building on a plat.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builder 3 & 2, (United States Navy, NAVPERS 10648-F, 1970), GPO D208.11:B68/3/970.

Kissam, Philip, Surveying Practice, (McGraw-Hill: 330 West 42nd Street, New York, New York 10036), 1971.

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Schmidt, John L., et.al., Construction - Principles, Materials and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Degrees and angles
- Scale measurements
- Square feet computations
- Level and plumb

Science

- Compass points
- Topography

Communication Skills

- Field notes interpretation
- Student Resource Manual
- Basic blueprint interpretation
- Junior and Senior College catalogs
- Occupational Outlook Handbook
- Manufacturer's literature
- Newspaper Want Ads

CONTENT TITLE: Surveying

SUB OBJECTIVE 5: Set up and align a transit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates set up and alignment of transit.

A. Protection of equipment.
B. Identify parts of transit and their care.
C. Set up tripod and rough adjust legs.
D. Attach instrument.
E. Attach plumb bob.
F. Adjust legs to center of plumb bob over Temporary Bench Mark (TBM).
G. Level instrument and level scope.
H. Loosen base, establish North and remove lens cover.

II. Student sets up and aligns a transit.

CONTENT TITLE: Surveying

SUB OBJECTIVE 6: Shoot lines and survey a plat.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor shoots a line.

A. Aim transit at specified direction.
B. Pull chain taut to establish distance.
C. With help of rodman, establish point.
D. Drive second TBM stake.

II. Student shoots two lines.

A. Repeat A through D as above.
B. Re-aim transit for second line.
C. With help of rodman, establish point.
D. Pull chain taut to establish distance.
E. Drive third TBM stake.
F. "Flip" transit for second and third TBM's and verify line.
G. Record all activities.

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

CONTENT TITLE: Surveying

SUB OBJECTIVE 7: Set up and level a batterboard.

SUGGESTED ACTIVITIES: (Student and Teachers)

I. Instructor demonstrates setting up a batterboard.

   A. Drive tie-stakes.
   B. Tie lines.

II. Student sets up a batterboard.

III. Instructor levels batterboard

   A. Sight string elevation at one tie point.
   B. Sight string elevation at another tie point.
   C. Adjust string until level.

IV. Student levels a batterboard.

V. Instructor demonstrates string level, garden hose, etc.

CONTENT TITLE: Surveying

SUB OBJECTIVE 8: Given complete field notes, develop a contour map.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses method used to establish grid data.

II. Instructor develops a contour map.

   A. Write elevation data on grid.
   B. Connect similar altitudes with contour lines.

III. Student develops a contour map from field notes.

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

OVERALL OBJECTIVE: Given a set of building plans, the student will determine ability to accurately (plus or minus 20%) estimate the materials cost for a small residential garage.

SOURCES OF INFORMATION

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1973.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Percentage
- Square and cubic feet computations
- Using concrete volume calculator

Communication Skills

- Blueprint interpretation
- Supply price lists and catalogs
- Student Resource Material
- Occupational Outlook Handbook
- Manufacturer's literature
- Junior and Senior College catalogs
- Newspaper Want Ads

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ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

CONTENT TITLE: Estimating

SUB OBJECTIVE 9: Given unit materials costs, accurately estimate the materials cost for the foundation of a roof.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating materials cost for a roof.

A. Compute area of roof surface in squares and feet using elevation and plot plans.
B. Compute number of decking sheets (4' x 8') required to deck roof and cost.
C. Compute number of squares of dry coat required and cost.
D. Compute number of squares of composition shingles and cost.
E. Count number of trusses required and cost.
F. Total costs.

II. Students estimate cost of composition roof for a garage.

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

CONTENT TITLE: Estimating

SUB OBJECTIVE 10: Given unit material costs, accurately estimate the materials cost for the foundation of a specified small residential garage.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating steel costs for foundation.

   A. Compute linear footage of reinforcement rod for beams and calculate cost.
   B. Compute linear footage of re-bar for slab and calculate cost.
   C. Determine number and cost of strips.
   D. Determine number and cost of saddles.

II. Students estimate cost of steel work for foundation.

III. Instructor demonstrates estimating concrete costs for foundation.

   A. Compute slab volume.
   B. Compute beam volume.
   C. Allow 25% compaction of volume.
   D. Compute cost.

IV. Students estimate concrete costs for foundation.

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

CONTENT TITLE: Estimating

SUB OBJECTIVE 11: Given unit material costs, accurately estimate the material cost for walls.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating materials cost for walls.

A. Count number of studs and corner post and compute board feet. Calculate linear footage of 2 x 4's for sole-plate and top plate. Compute cost.
B. Calculate area and number of sheets of sheathing required for outside walls and cost.
C. Calculate area, number of sheets of wall-board required and cost.
D. Compute number of square of siding required and cost.
E. Add costs for total.

II. Students estimate material cost for walls.

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

OVERALL OBJECTIVE: Given the lengths of time required for each phase of a small residential construction task, the student will determine ability to draw a pert chart to illustrate the sequential and/or simultaneous nature of the work and to calculate a completion deadline.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Construction Electrician 1 & C, (United States Navy, NAVPERS 10637-D, 1970), GPO #D208.11:E12/8/970.

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Graph making

Communication Skills

- Student Resource Manual
- Basic blueprint interpretation
- Occupational Outlook Handbook
- Junior and Senior College catalogs
- Newspaper want ads

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

CONTENT TITLE: Expediting

SUB OBJECTIVE 12: Prepare a simple pert chart.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates using paper strips and other devices to prepare pert charts.

   A. Take estimated times and cut strips to appropriate length, labeling according to function.
   B. Arrange sequential functions in a row; arrange other functions appropriately to indicate their depending upon one or more prior functions, laying them parallel to indicate they may be accomplished simultaneously to other functions.
   C. Prepare chalkboard, overhead projector or other type demonstration from paper strips, including line of dependency.

II. Students prepare a pert chart.

CONTENT TITLE: Expediting

SUB OBJECTIVE 13: Discuss, as a group, preparing sequencing plans for a building operation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses construction outlining the steps normally involved in building a small-to-medium sized residence.

II. Instructor and students discuss and determine possible parallel channels of activity (i.e., ductwork, insulating, outside birch and other phases of construction may take place simultaneously).

III. Students discuss building sequences and linear and parallel functions of small residence construction.

IV. Students as groups prepare a list of start-up order for phases of small-residence construction, indicating areas of linear dependence.

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

OVERALL OBJECTIVE: Given an information sheet outlining basic specifications for electrical installation in a small residence, the student will attempt to determine a contractor's conformance or non-conformance to the specifications.

SOURCES OF INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Building code numbering system

Communications Skills

- Building code interpretation
- Safety information
- Student Resource Manual
- Occupational Outlook Handbook
- Basic blueprint interpretation
- Use of construction check lists
- Newspaper want ads

ENGINEE[illegible] SUPPORT AND MANAGEMENT SERVICES

CONTENT TITL[illegible] Testing and Inspecting

SUB OBJECTIVE 14: Identify by name those items or materials and describe the purpose or function of those items or materials as used in small residence construction.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates use of specification sheets.

A. Display hardware likely to be encountered, especially those items or materials called for in specifications.

B. Discuss uses of these items or materials in relation to function, safety appearance, etc.

II. Students identify and discuss use of items or materials on resource sheet.

CONTENT TITLE: Testing and Inspecting

SUB OBJECTIVE 15: Practice using a checklist on a construction site.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates relationship between checklist and specifications, and demonstrates use of checklist, checking off each compliance, and/or non-compliance in a room other than the kitchen or room which students are to inspect.

II. Students, using checklist, inspect kitchen, checking for compliance or non-compliance with checklist.

METAL

METAL

OVERALL OBJECTIVE: The student will determine ability to operate safely oxyacetylene and arc welding equipment to cut and fasten metals in butt, lap and T-joints.

SOURCES OF INFORMATION

Althouse, Turnquist and Bowditch, Modern Welding, (Goodheart-Wilcox Co. Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1970.

Giachino, J. W., Welding Technology, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60673), 1968.

Giachino, J. W., Welding Skills and Practices, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

National Safety Council, (425 North Michigan Avenue, Chicago, Illinois 60611).

Safety Bulletins, (American Welding Society: 2501 North West 7th Street, Miami, Florida 33125).

Schmidt, John L. et.al., Construction - Principles, Materials and Methods (American Savings and Loan Institute Press, 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math
- Measuring
  - Whole numbers
  - Fractions
  - Decimals

Science
- The welding of metals

Communication Skills
- Related safety information
  - Oxyacetylene equipment operation
  - Arc welding equipment operation
- Manufacturer's literature
- Student Resource Material
- Occupational Outlook Handbook
- Newspaper want ads

METAL

CONTENT TITLE: Welding

SUB OBJECTIVE 1: Set up, adjust and use an oxyacetylene torch to form a puddle.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates setting up and adjusting oxyacetylene torches.

   A. Safety.
   B. Identify parts of oxyacetylene equipment -- regulators, tanks, jets, etc.
   C. Set oxygen pressure.
   D. Set acetylene pressure.
   E. Demonstrate proper flame adjustment -- carbonizing flames, neutral, oxidizing flame.

II. Instructor demonstrates use of torch.

   A. Form a puddle.
   B. Add rod.

III. Instructor demonstrates shut-down of torch.

   A. Shut torch down.
   B. Bleed pressure off acetylene regulator.
   C. Bleed pressure off oxygen regulator.

IV. Students use the oxyacetylene torch.

   A. Set oxygen pressure
   B. Set acetylene pressure.
   C. Ignite torch.
   D. Adjust for neutral flame.
   E. Form puddle on plate steel and experiment with torch, making puddles and cutting material, etc.
   F. Shut torch off.
   G. Bleed pressure off acetylene regulator.
   H. Bleed pressure off oxygen regulator.

METAL

CONTENT TITLE: Welding

SUB OBJECTIVE 2: Weld a butt joint, using an oxyacetylene torch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing metal and welding a butt joint.

A. Safety.
B. Cut metal to size.
C. Prepare metal for welding.
D. Tack weld two pieces of metal together to form a butt joint.
E. Form puddle with torch and add rod.
F. Weld butt joint.
G. Shut torch off.

II. Student welds a simple butt joint.

CONTENT TITLE: Welding

SUB OBJECTIVE 3: Weld a lap joint using an oxyacetylene torch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a lap joint.

A. Cut and prepare metal.
B. Set up torch.
C. Tack weld two pieces of metal to form lap joint.
D. Weld lap joint.
E. Discuss characteristics of a good weld.

II. Student welds a lap joint.

METAL

CONTENT TITLE: Welding

SUB OBJECTIVE 4: Adjust and safely operate an arcwelding machine.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates proper machine adjustment.

A. Turn on machine.
B. Adjust amperage according to electrode size and metal thickness.

II. Instructor demonstrates running beads on plate.

A. Strike an arc and form a puddle.
B. Run beads on plate.

III. Student runs beads on a plate.

A. Turn machine on.
B. Adjust machine for correct amperage.
C. Strike arc and experiment with arc welder running beads, etc.

CONTENT TITLE: Welding

SUB OBJECTIVE 5: Weld a butt joint using an arc welding machine.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding butt joints with a manual shielded arc welder.

A. Cut metal to size.
B. Prepare metal for welding.
C. Set up welder.
D. Tack weld metal to form a butt joint.
E. Weld butt joint.

II. Student welds a butt joint.

METAL

CONTENT TITLE: Welding

SUB OBJECTIVE 6: Weld a lap joint, using an electric arc welding machine.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding lap joints using an electric arc welding machine.

   A. Cut metal to size.
   B. Prepare metal for welding.
   C. Set up welder.
   D. Tack weld metal to form a lap joint.
   E. Weld a lap joint.

II. Students welds a lap joint.

CONTENT TITLE: Welding

SUB OBJECTIVE 7: Weld a T-joint using an electric arc welding machine.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a T-joint using an electric arc welding machine.

   A. Cut metal to size.
   B. Prepare metal for welding.
   C. Set up welder.
   D. Tack weld metal to form a T-joint.
   E. Weld a T-joint.

II. Student welds a T-joint.

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METAL

OVERALL OBJECTIVE: The student will determine ability to safely fasten pipes by soldering, threading and gluing.

SOURCES OF INFORMATION

Daniels, George, Home Guide to Plumbing, Heating and Air Conditioning, (Popular Science Publishing Co.: 355 Lexington Avenue, New York, New York 10017), 1967.

Lang, Paul V., Principles of Air Conditioning, (Delmar Publishers: P. O. Box 5082, Albany, New York 12205), 1968.

Mathias, A. J. and Esles Smith, How To Design and Install Plumbing, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60634), 1967.

Oravetz, Jules, Plumbers and Pipe Fitters Library, 3 Vols., (Theodore Audel and Co., Division of Howard W. Sams and Co., Inc.: 4200 West 62nd Street, Indianapolis, Indiana), 1967.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals

Science

- Solders and fluxes

Communication Skills

- Related safety information
  - Soldering practices
  - Threading tools
- Manufacturer's literature
- Student Resource Manual
- Occupational Outlook Handbook
- Newspaper want ads
  - Plumbers
  - Air conditioning and heating

METAL

CONTENT TITLE: Plumbing

SUB OBJECTIVE 8: Fasten PVC Tubing

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor lectures on plumbing.

II. Instructor demonstrates joining PVC tubing to PVC tee or ell.

A. Select two pieces of 1/2" PVC tubing approximately 10" long.
B. Clean cut edges.
C. Apply adhesive to pipe.
D. Insert pipes into tee or ell.

III. Student cuts and connects PVC piping without adhesive.

METAL

CONTENT TITLE: Plumbing

SUB OBJECTIVE 9: Fasten copper tubing by soldering.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor lectures on Refrigeration and Air Conditioning.

II. Instructor demonstrates joining copper tubing with solder.

A. Select size of tubing and cut to length (two 4" pieces).
B. Swedge one end of tubing.
C. Clean ends of tubing and join together.
D. Heat tube, then fitting with oxyacetylene torch.
E. Apply solder.
F. Allow to cool and test the joint.

III. Student solders a copper tubing joint.

INSTRUCTOR NOTE: If possible, present a working refrigeration unit canibalized from an old refrigerator. Replace the evaporator unit with a piece of 1/2" copper tubing connected to capillary tubing and suction line and have students feel and examine this unit while operating.

METAL

CONTENT TITLE: Plumbing

SUB OBJECTIVE 10: Cut, thread and fasten pipe to form a water line.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor lectures on plumbing and working with pipe.

II. Instructor demonstrates use of hand pipe threaders.

A. Select pipe size -- black or galvanized pipe (one 6" piece).
B. Cut and de-burr pipe.
C. Adjust hand pipe threader.
D. Thread pipe.

III. Student threads pipe.

A. Select pipe size.
B. Cut and de-burr pipe.
C. Adjust hand pipe threader.
D. Thread pipe.

IV. Students make up a water line with a faucet.

A. Cut and thread pipe as per drawing.
B. Connect pipe with couplers.
C. Install an elbow on the end of the pipe.
D. Install water faucet.

METAL

OVERALL OBJECTIVE: The student will determine ability to fasten sheet metal by soldering, hemming and riveting and to operate the sheet metal brake and forming machine to bend and form sheet metal.

SOURCES OF INFORMATION

Feirer, John L. and John R. Lindbeck, Metalwork, (Chas. A. Bennett Co., Inc.: 809 West Detweiller Drive, Peoria, Illinois 61614), 1970.

Gardner, Boyd T., Metalworking, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), rev. ed. 1968.

Tustison, F. E., Kranzusch and Blide, Metalworking Essentials, (Bruce Publishing Co.: 2642 University Avenue, St. Paul, Minnesota 55114), 1962.

Wilkinson, H., Basic Sheet Metal Work, (St. Martin Press: 866 Third Avenue, New York, New York 10022), 1964.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material sizing
- Squaring and layout
- Scale dimensions

Science

- Galvanized materials

Communication Skills

- Working drawings and blueprints
- Manufacturer's literature
- Related safety - handling sheet metal
- Student Resource Manual
- Occupational Outlook Handbook
- Newspaper Want Ads

CONTENT TITLE: Sheet Metal Working

SUB OBJECTIVE 11: Tin a copper and fasten sheet metal by soldering.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates tinning copper and soldering joints.

A. File the faces of the point with a mill file.
B. Heat copper.
C. Rub copper on salammoniac block.
D. Apply small amount of solder and copper.
E. Clean surfaces to be soldered.
F. Clamp pieces of sheet metal together.
G. Flux area to be soldered.
H. Solder joint.

II. Students tin copper and solder joints.

CONTENT TITLE Sheet Metal Working

SUB OBJECTIVE 12: Brake-bend sheet metal to form a square tube.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates using a sheet metal brake.

A. Adjust sheet metal brake for thickness of metal to be worked.
B. Cut and lay out metal to be used.
C. Demonstrate 90° brake.
D. Demonstrate forming a square tube.

II Students brake-bend galvanized sheet.

A. Measure, cut and lay out sheet to be worked.
B. Brake-bend sheet to form square tube.
C. Solder seam completing tube or duct.

METAL

CONTENT TITLE: Sheet Metal Working

SUB OBJECTIVE 13: Operate a sheet metal forming machine to roll formed sheet metal, of specific thickness, into a cylinder of specified diameter.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates rolling sheet metal on forming machine.

A. Demonstrate adjusting rolls for thickness of metal and diameter of tube required.
B. Cut metal to size.
C. Roll a tube.

II. Students operate sheet metal forming machine.

A. Adjust roll for thickness of metal and appropriate diameter.
B. Cut metal to size.
C. Roll sheet metal to form a tube.
D. Solder seam on sheet metal tube.

METAL

CONTENT TITLE: Sheet Metal Working

SUB OBJECTIVE 14: Hem and fasten sheet metal.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates forming a single hem.

A. Cut sheet metal to size.
B. Form single hem with mallet and a block of wood.

II. Demonstrate single hem using a bar folder.

A. Cut metal to size.
B. Form hem using bar folder.

III. Student forms single hem using mallet and block of wood.

A. Cut metal to size.
B. Form hem using mallet.

IV. Student forms single hem using bar folder.

A. Cut metal to size.
B. Form single hem.

V. Instructor demonstrates joining sheet metal using a single hem.

A. Instructor forms a single hem on two pieces of sheet metal.
B. Instructor joins pieces of sheet metal using a single hem.

VI. Students join sheet metal using a single hem.

A. Cut metal to size.
B. Form single hem on both sheets.
C. Join pieces of sheet metal with a single hem.

VII. Instructor demonstrates double hemming.

A. Form double hem using bar folder.
B. Join sheet metal using a double hem.

Continued ...

CONTENT TITLE: Sheet Metal Working

SUB OBJECTIVE 14: Hem and fasten sheet metal. (continued)

SUGGESTED ACTIVITIES: (Students and Teachers)

VIII. Students form a square duct as per drawing using a single hem.

A. Lay out and cut metal to size.
B. Brake-bend sheet metal to form a square duct.
C. Join hems to complete duct.

IX. Students form a square duct as per drawing using double hem.

A. Lay out and cut sheet metal.
B. Form double hem on two edges.
C. Brake-bend sheet metal to form a square duct.
D. Join hems to complete duct.

CONTENT TITLE: Sheet Metal Working

SUB OBJECTIVE 15: Fasten sheet metal by riveting.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates setting rivets.

A. Select rivets to be used.
B. Lay out location of rivets.
C. Drill or punch holes.
D. Set rivets.

II. Students rivet sheet metal.

METAL

CONTENT TITLE: Pipe Fitting

SUB OBJECTIVE 16: Prepare a template for an orange peel head.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor lectures on pipe fitting.

   A. Reading blueprints.
   B. Making templates.

II. Instructor demonstrates making a template for an orange peel head.

   A. Develop a template for an orange peel head on 3" standard weight pipe twelve inches long.

III. Student makes a template for an orange peel head on 3" standard pipe.

   A. Draw template on heavy drawing paper.
   B. Cut out template.
   C. Transfer template to a piece of 3" standard pipe.

CONTENT TITLE: Pipe Fitting

SUB OBJECTIVE 17: Using a template, make an orange peel head.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates using a template for an orange peel head.

   A. Cut out template and transfer to a piece of 3" pipe.
   B. Cut pipe with torch and complete orange peel head.

II. Student makes an orange peel head on 3" standard pipe.

   A. Cut orange peel head on 3" standard pipe.
   B. Bend arms of orange peel to form a head.
   C. Weld arms together.

METAL

CONTENT TITLE: Pipe Fitting

SUB OBJECTIVE 18: Given a drawing, the student will draw a template and use it to make a two-piece, 90° turn.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor makes a two-piece, 90° turn.

   A. Develop template and transfer to pipe.
   B. Cut, fit, check with a square and weld turn.

II. Students make a template for a two-piece 90° turn.

   A. Lay out the angle of the turn.
   B. Draw template as per drawing and information sheet.

III. Student uses template and develops a two-piece 90° turn on 3" standard pipe.

   A. Transfer template to the pipe to be used.
   B. Cut pipe.
   C. Fit pipes together.
   D. Check with a square.
   E. Weld two-piece, 90° turn.

ELECTRICITY

ELECTRICITY

OVERALL OBJECTIVE: The student will layout and construct a simple series and a parallel circuit.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637).

Gerrish, Howard H., Electricity, (The Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1964.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material sizing

Science

- Essentials of series and parallel circuits
- Conductors
- Insulators

Communication Skills

- Working drawings
- Student Resource Manual
- Occupational Outlook Handbook
- Related safety information
- Newspaper want ads
- Apprenticeship information

ELECTRICITY

CONTENT TITLE: Simple Electrical Circuit

SUB OBJECTIVE 1: Construct a simple electrical circuit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates constructing a simple circuit.

A. Identify components of the circuit--conductors, insulators, etc.
B. Trace flow of electricity.
C. Introduce basic electrical color codes (white, black, green and red).
D. Identify electrical source and electrical loads.
E. Demonstrate proper connection techniques using wire loops, solderless connectors, solder and tape.
F. Stress safety throughout demonstration.
G. Identify special tools and equipment.

II. Students construct a simple circuit.

A. Use porcelain lamp base or pigtail light for project.
B. Use #14 wire (white and black) or extension cord.
C. Connect wires and have instructor check before testing.
D. Test project using alligator clip test cord.
E. Discuss or list common hazards that should be avoided.

ELECTRICITY

CONTENT TITLE: Simple Electrical Circuits

SUB OBJECTIVE 2: Observe the operation of and construct a parallel curcuit and a series circuit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor describes parallel and series circuits and illustrates their connection in junction boxes.

   A. Describe parallel circuits branching from original circuit.
   B. Mention presence of 115V on all lines out of connections.
   C. Connect several lights to one circuit in parallel.

II. Students construct a parallel circuit.

   A. Connect three lights in parallel (pigtail lights).
   B. Tape call connections.
   C. Test circuit.
   D. Review properties of parallel circuits.

III. Students construct a series circuit.

ELECTRICITY

OVERALL OBJECTIVE: The student will determine ability to mount the hardware for, install and connect electrical boxes, switches and receptacles.

SOURCES OF INFORMATION

Alerich, Walter, N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

Gerrish, Howard H., Electricity, (The Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1964.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
- Material sizing
  - Wire
  - Utility boxes

Communication Skills

- Working drawings and simple blueprint interpretations
- Related safety information
- Student Resource Manual
- Occupational Outlook Handbook
- Occupational briefs
- Apprenticeship information
- Newspaper want ads

ELECTRICITY

CONTENT TITLE: Installing Electrical Hardware

SUB OBJECTIVE 3: Mount utility and 4/0 electrical boxes.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates mounting boxes to walls and ceilings.

A. Explain purposes of electrical boxes.
B. Demonstrate simple box connections and methods of placement.
C. Connect switch and receptacle mounting to box.
D. Place box covers.
E. Stress safety throughout demonstration.
F. Describe special tools and equipment.

II. Students mount a utility box.

A. Measure and lay out for box placement.
B. Install switch without wires.
C. Install 115-V receptacle without wires.
D. Install cover plates.

III. Students mount 4/0 box to ceiling using ladder and stressing safety.

A. Connect porcelain light base to box without wire connections.
B. Use tool pouch to carry common tools and supplies.

ELECTRICITY

CONTENT TITLE: Installing Electrical Hardware

SUB OBJECTIVE 4: Install a SPST switch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing a single pole, single throw switch.

A. Explain opened and closed circuits.
B. Demonstrate common wiring mistakes and results (short circuits).
C. Introduce symbol for SPST switch.
D. Stress safety throughout demonstration.
E. Describe special tools and equipment.

II. Student wires in a switch.

A. Measure, lay out and cut wire.
B. Install light as part of circuit.
C. Connect switch to simple circuit.
D. Mount switch to box.
E. Install cover plate.
F. Test switch in circuit.
G. Draw rough diagram of project.
H. Discuss student drawings.

ELECTRICITY

CONTENT TITLE: Connecting Electrical Equipment

SUB OBJECTIVE 5: Make simple wire connections using electrical tape and mechanical connectors.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing different types of wire connections in junction boxes.

   A. Discuss color code, i.e., white to white, black to black and ground wires too (14-2 Romex with ground).
   B. Solder and tape for a pigtail splice.
   C. Demonstrate using wire nuts for pigtail splice.
   D. Mount cover on junction box.
   E. Emphasize safety throughout demonstration.
   F. Introduce new tools and equipment.

II. Students make wire connections using solder, tape and wire nuts.

   A. Make connections in junction boxes using 14-2 Romex.
   B. Inspect for proper connections.
   C. Mount cover to box.
   D. Test circuits.

ELECTRICITY

CONTENT TITLE: Installing Electrical Hardware

SUB OBJECTIVE 6: Install and connect a 115V duplex receptacle.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing a duplex receptacle.

A. Discuss color code, i.e., black to gold, white to silver (right hand wire loops).
B. Discuss purpose of ground wire (green).
C. Introduce common wire types and sizes and electrical symbol for receptacle.
D. Stress safety through out demonstration.
E. Introduce special tools and equipment.

II. Student wire and place a 115V duplex receptacle.

A. Measure and lay out for placement of utility box.
B. Install utility box.
C. Measure, lay out and cut wire.
D. Connect receptacle to wires.
E. Mount receptacle to box.
F. Install cover plate.
G. Test project.
H. Draw rough diagram of project.
I. Discuss drawing and uses of symbols.

ELECTRICITY

CONTENT TITLE: Installing Electrical Hardware

SUB OBJECTIVE 7: Install and connect a three-way switch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates and diagrams installation of a three-way switch.

   A. Discuss unusual wiring process.
   B. Identify line in and line out placement.
   C. Identify common wire placement.
   D. Identify traveler wires and connections.

II. Students install and mount three-way switch.

ELECTRICITY

OVERALL OBJECTIVE: The student will observe and trace the distribution of electricity through a building and will install and connect the typical electrical components of a single residential room.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

Jones and Johnston, Adequate Wiring for Home and Farm, (The Bruce Publishing Company: 2642 University Avenue, St. Paul, Minnesota 55114), 1963.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measurement

Science

- Typical electrical systems and components

Communication Skills

- Simple blueprint interpretation
- Student Resource Manual
- Occupational Outlook Handbook
- Review career opportunities in electricity

ELECTRICITY

CONTENT TITLE: Complete Systems

SUB OBJECTIVE 8: Observe and trace the distribution of electricity through a building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces blueprints and symbols.

   A. Relate the real job of wiring to blueprint drawings and symbols.
   B. Emphasize teamwork and construction sequence of work.

II. Instructor illustrates typical electrical distribution throughout a building.

   A. Point out service drop.
   B. Point out meter and main disconnect.
   C. Point out circuit breaker panels.
   D. Point out individual circuits and loads.

III. Students trace distribution of electricity throughout a building.

   A. Identify on block diagrams and other blueprints the major areas of electrical distribution.
   B. Identify service drops, meters and main disconnects and circuit breaker panels.
   C. Relate load areas to blueprints.

ELECTRICITY

CONTENT TITLE: Complete Systems

SUB OBJECTIVE 9: Install and connect a light fixture controlled by a SPST switch, a standard duplex receptacle and a pullchain light fixture in a circuit to be designed by the instructor.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor outlines project.

   A. Draw circuit diagram.
   B. Lay out Installation.
   C. Outline task.

II. Students installs equipment.

   A. Run wire.
   B. Install hardware.
   C. Connect equipment.
   D. Test installation.

MASONRY

MASONRY

OVERALL OBJECTIVE: The student will determine ability to work with brick and mortar to build walls and corners on height, and to level, plumb and straightedge work.

SOURCES OF INFORMATION

Bricklayer's Vocational Training Textbook, (Brick Institute of America: 1750 Meadow Road, McLean, Virginia 22101), 1968.

Bricklaying I, (DelMar Publishers: P. O. Box 5087, Albany, New York), 1952.

Bricklaying II, (DelMar Publishers: P. O. Box 5087, Albany, New York).

Ray, J. E., The Art of Bricklaying, (Charles A. Bennett Co.: 809 West Detwieller Drive, Peoria, Illinois), 1972.

Schmidt, John L., et.al., Construction - Principles, Materials and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1972.

Vocational and Apprenticeship Training Trade Projects #2, (Brick Institute of America: 1750 Meadow Road, McLean, Virginia 22101).

Vocational and Apprenticeship Training Trade Projects #5, (Brick Institute of America: 1750 Meadow Road, McLean, Virginia 22101).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Level, plumb and square

Science

- Masonry and ceramic products

Communication Skills

- Blueprint introduction
- Working drawings and symbols
- Student Resource Manual
- Occupational Outlook Handbook
- Newspaper Want Ads
- Industry career information

MASONRY

CONTENT TITLE: Mixing Mortar

SUB OBJECTIVE 1: Mix mortar.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses mortars and their uses

A. Discuss masonry mortar.
B. Discuss Portland and lime mortar.
C. Discuss sand and lime mortar.

II. Instructor demonstrates mixing sand and lime mortar.

A. Measure ingredients.
B. Mix dry ingredients.
C. Add water and mix.

III. Students mix mortar.

CONTENT TITLE: Spreading Mortar

SUB OBJECTIVE 2 Spread mortar.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates spreading mortar.

A. Collect mortar on trowel.
B. Start spreading; apply 1/2" to 5/8" thick, 3-5/8" to 4" wide.
C. Spread about 8' long; this should require 3 trowels.

II. Students spread mortar.

MASONRY

CONTENT TITLE: Buttering Brick

SUB OBJECTIVE 3: Butter brick preparatory to laying right to left to right.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates buttering a stretcher while facing the wall.

A. Butter face and end of brick.
B. Lay in mortar bed.
C. Press to level.
D. Trim excess mortar from joint.
E. Repeat and continue, working from right to left.
F. Reverse buttering, and work from left to right as above.

II. Students butter bricks.

CONTENT TITLE: Laying Brick to a Line

SUB OBJECTIVE 4: Lay brick to a line.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor should erect two vertical, plumb 2 x 4's, 4 feet high at an adequate distance apart to provide at least 4 feet of work space for each student. Mark off brick course heights making allowances in first course for more or less mortar to ensure that the course is level. Hang up line and lay out dry brick.

II. Instructor demonstrates laying brick to a line.

A. Spread mortar.
B. Lay first brick dry.
C. Butter and lay next brick.
D. Press brick level to the line.
E. Repeat C and D until all bricks are laid.

III. Students lay brick to a line.

MASONRY

CONTENT TITLE: Introducing Use of the Level

SUB OBJECTIVE 5: Care for and use the level while building a 4", all-stretcher wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces the bricklayer's 48" wood level.

   A. Identify parts.
   B. Stress the fact that the level is the most expensive hand tool that the bricklayer uses.
   C. Stress proper care of the level.

II. Instructor demonstrates using the level.

   A. Start course on height using scale #6 on the modular rule.
   B. Lay course and level from point of height.
   C. Plumb course from both ends and face, using plumb rule.
   D. Straightedge brick between two faces using plumb rule.

III. Students use a bricklayer's level.

CONTENT TITLE: Build a 4" Corner in Common Bond

SUB OBJECTIVE 6: Build a 4" corner, all-stretchers.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out a corner.

A. Spread mortar.
B. Lay corner brick dry.
C. Butter and lay adjacent brick.
D. Continue each direction as for a straight course, following the 4 steps of bricklaying: (a) keep it on height; (b) level from the point of height; (c) plumb the work; and (d) straight-edge the work.
E. Spread mortar and lay second corner brick in opposite direction.
F. Repeat A through D.

II. Students lay out a corner.

CONTENT TITLE: Reading Bricklayer's Rule

SUB OBJECTIVE 7: Read and use the three bricklayer's rules.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates using the three bricklayer's rules.

A. Demonstrate 6' folding rule.
B. Demonstrate 6' modular rule.
C. Demonstrate 6' spacing rule.

II. Student will read, explain and practice using rules.

A. Practice using 6' folding rule.
B. Practice using 6' modular rule.
C. Practice using 6' spacing rule.

MASONRY

OVERALL OBJECTIVE: The student will determine ability to work with blocks and mortar to build walls and corners on height and to level, plumb and straightedge the work.

SOURCES OF INFORMATION

Recommended Practices for Laying Concrete Block, (Portland Cement Association: Old Orchard Road, Skokie, Illinois 60076).

Schmidt, John L., et.al., Construction - Principles, Materials and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson, Danville, Illinois 61832), 1972.

Type of Workmanship Recommended for Concrete Block Walls, (Louisville Cement Co.: 501 South Second, Louisville, Kentucky 40202), 1958.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Ratios and proportions
- Degrees and angles

Science

- Properties of cement and mortar

Communication Skills

- Student Resource Manual
- Trade and technical materials
- Apprenticeship information
- Industry career information

MASONRY

CONTENT TITLE: Spread Mortar and Butter Block for Block Laying

SUB OBJECTIVE 8: Spread mortar and butter blocks for block-laying.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor erects two vertical, plumb 2 x 4's, 4 feet high at an adequate distance apart to provide at least 4 feet of work space for each student. Mark off block course heights (8" high), making allowance in first course for more or less mortar to ensure that the course is level. Hang up line and lay out or dry bond block.

II. Instructor demonstrates spreading mortar and buttering blocks.

A. Spread mortar for first course.
B. Lay first block dry.
C. Butter block and lay first course, demonstrating the difference between buttering brick and buttering block.
D. Spread mortar on top of first course, demonstrating the difference in technique.

III. Students spread mortar and butter blocks.

A. Spread mortar for first course.
B. Lay first block dry.
C. Butter block and lay first course.
D. Spread mortar on top of first course.
E. Continue A through D as needed to develop skill and speed.

CONTENT TITLE: Laying 8" Block

SUB OBJECTIVE 9: Lay 8" block to a line.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor erects two vertical, plumb 2 x 4's, 4 feet high at an adequate distance apart to provide at least 4 feet of work space for each student.

II. Instructor demonstrates laying block to a line.

A. Spread mortar.
B. Lay first block dry.
C. Butter and lay next block.
D. Ease block down to the line.
E. Repeat C and D.

III. Students lay block to a line.

CONTENT TITLE: Using the Level to Build an 8" Block Corner

SUB OBJECTIVE 10: Build an 8" block corner using the level.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building a block corner.

A. Lay out corner.
B. Spread mortar.
C. Lay corner block dry.
D. Butter and lay adjacent block.
E. Continue each direction as for a straight course, following the four steps of bricklaying.
F. Spread mortar and lay second corner block in opposite direction.
G. Repeat A through G.

II. Students lay out a block corner.

MASONRY

OVERALL OBJECTIVE: The student will lay out, lay, cut and apply grout to tile for a kitchen drainboard.

SOURCES OF INFORMATION

Brann, Donald R., How to Lay Ceramic Tile, (Directions Simplified, Inc.: Briarcliff Manor, New York), 1966.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Computing Square Feet

Communication Skills

- Student Resource Manual
- Trade and technical information
- Newspaper want ads
- Occupational Outlook Handbook
- Industry career information

CONTENT TITLE: Tilesetting

SUB OBJECTIVE 11: Cut and fit tile using nippers, chipping hammers and mechanical tile cutters.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates cutting and fitting tile in corners, angles, holes.

A. Demonstrate using tile nippers.
B. Demonstrate using hole breakers.
C. Demonstrate using chipping hammers.
D. Demonstrate using mechanical tile cutter.

II. Students practice using tile cutting tools.

A. Measure and cut tile with nippers.
B. Measure and cut tile with hole breakers.
C. Measure and cut tile with chipping hammers.
D. Measure and cut tile with mechanical tile cutters.

CONTENT TITLE: Tilesetting

SUB OBJECTIVE 12: Lay out and set tile on a kitchen splash and drain board.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and setting tile.

A. Measure and determine center of work area (work center-to-outside, front-to-back and bottom-to-top).
B. Nail front water stop in place.
C. Set bottom edge of splash tile, (lightly and then level).
D. Set all of splash.
E. Set cap edge and quarter round trim around the edge of the sink.
F. Set drain deck tile (cutting 45° angles, pieces, corners, etc.).

II. Students lay out and set tile.

MASONRY

CONTENT TILE: Tilesetting

SUB OBJECTIVE 13: Grout a tile splash and drain board.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates grouting in tile.

A. Mix grout.
B. Spread grout with stiff water brush.
C. Brush in grout both ways until all joints are full.
D. Squeegee semi-clean (remove excess grout).
E. Allow to set.
F. Sponge clean.
G. Polish with clean cheesecloth.

II. Students grout in tile.

MASONRY

OVERALL OBJECTIVE: The student will plaster a wall.

SOURCES OF INFORMATION

Schmidt, John L., et.al., Construction - Principles, Materials and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Student Resource Manual
- Trade and technical literature
- Industry career information
- Newspaper want ads

MASONRY

CONTENT TITLE: Using Plastering Hawk and Trowel to Apply Base Coat

SUB OBJECTIVE 14: Use the plastering trowel to remove mortar from the hawk and apply base coat and finishing coat of plaster to back of masonry wall.

SUGGESTED ACTIVITIES: (Student and Teachers)

I. Instructor demonstrates plastering a base coat on a wall.

A. Mix mortar.
B. Wet wall.
C. Apply plaster, using hawk and trowels and the double-back method.
D. Scratch work.
E. Apply second coat (double-up) immediately following first application.
F. Rod and darby.

II. Instructor demonstrates plastering a finish coat on a wall.

A. Mix putty (finish) coat.
B. Wet wall.
C. Apply first coat of finishing mortar.
D. Apply second coat of finish material immediately after using the first coat; work left to right.
E. Use putty (finish mortar) to cover and fill in "cat faces" (blemishes or small rough depressions). Use brush to wet work and trowel to compress material.
F. Wet brush, and trowel smooth a second time.

III. Students plaster a masonry wall.

MASONRY

OVERALL OBJECTIVE: The student will determine ability to build forms for, pour and finish a concrete walk.

SOURCES OF INFORMATION

Schmidt, John L., et.al., Construction - Principles, Materials and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson, Danville, Illinois 61832), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review math requirements for skill training in masonry group

Science

- Review science requirements for skill training in masonry group

Communication Skills

- Review communication skills requirements for skill training in masonry group
- Review career and job opportunities in masonry group including post-secondary education

CONTENT TITLE: Constructing Forms for Concrete Sidewalk

SUB OBJECTIVE 15: Construct forms for a concrete sidewalk.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates constructing formwork for a sidewalk.

A. Excavate or fill as necessary.
B. Lay out forms using stakes and string lines.
C. Position form sides. Temporary shore into position.
D. Plumb and square form sides. Stake into permanent position.
E. Lay out wire mesh. Support on rocks or raised areas to keep off of ground.
F. Position other supports.

II. Students construct forms for a concrete sidewalk.

CONTENT TITLE: Pouring and Finishing Sidewalk

SUB OBJECTIVE 16: Pour and finish a walk.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates pouring and finishing a walk.

A. Pour concrete.
B. Screed concrete to bring to level.
C. Jitterbug concrete to bring gravel below surface and remove entrained air.
D. Float surface to make smooth.
E. Allow to set before brushing, hosing, etc. for special finishes.
F. Finish work by adding stress relief racks, etc.

II. Students pour and finish a walk.

HEAVY EQUIPMENT

HEAVY EQUIPMENT

OVERALL OBJECTIVE: The student will identify and describe the various types of heavy equipment used in the construction industry; relate those items to the principal types of construction projects described by instructor.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Equipment Operator 3 & 2, (United States Navy, NAVPERS 10640-F, 1969), GPO D208.11:Eq5/969.

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701).

HEAVY EQUIPMENT

CONTENT TITLE: Types of Heavy Equipment

SUB OBJECTIVE 1: Recognize different types of machinery and the purpose of each.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses purpose of this course.

A. Introduce students to heavy equipment operations and its economic value.
B. Provide exposure to and experience in the field of heavy equipment operation.
C. Establish a realistic view of the environment of heavy equipment operations.
D. Provide information and experience for tentative career decision.

II. Instructor discusses general safety.

A. Introduce basic causes of accidents.
B. Identify general safety rules.
C. Formulate first aid and accident procedures.

III. Instructor illustrates the types of construction projects on which heavy equipment is used, such as residential, industrial commercial, conservation, highway and public utility.

IV. Instructor discusses types of application of most common heavy equipment.

A. Boom equipment. (Cranes, dragline, shovel, backhoe, gradall, etc.)
B. Earth-moving equipment. (Bulldozer, motorgrader, motorscraper, end loader, etc.)
C. Discuss plant equipment and paving equipment.
D. Discuss component parts of each machine.
E. Describe machine's operation and application.

Continued ...

HEAVY EQUIPMENT

CONTENT TITLE: Types of Heavy Equipment

SUB OBJECTIVE 1: Recognize different types of machinery and the purpose of each. (continued)

SUGGESTED ACTIVITIES: (Students and Teachers)

V. Student identifies and describes various types of heavy equipment.

A. Identify boom equipment.
B. Identify earth-moving equipment.
C. Discuss plant equipment and paving equipment.
D. Locate and describe component parts of each machine named.
E. State basic purpose of each machine.
F. Describe physical action of each in reference to job application.

HEAVY EQUIPMENT

OVERALL OBJECTIVE: The student will determine ability to identify and state the function of each of the five engine systems and each of the major components of a power train.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Equipment Operator 3 & 2, (United States Navy, NAVPERS 10640-F, 1969), GPO D208.11:Eq5/969.

Nichols, Herbert L., Moving the Earth, (North Castle Books: 212 Bedford Road, Greenwich, Connecticut 06830), 1962.

FILMS

ABC's of Automobile Engines

ABC's of Diesel Engines

Available from your local TEREX or GMC dealer, or write to TEREX-GMC Earth-moving Equipment Division, General Motors Building, Detroit, Michigan 48202.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Internal combustion engine
  - Air
  - Fuel
  - Ignition
- Simple machines

Communication Skills

- Student Resource Manual
- Occupational Outlook Handbook
- Manufacturer's literature
- Related safety information
- Newspaper want ads

HEAVY EQUIPMENT

CONTENT TITLE: Engine Systems and Power Train

SUB OBJECTIVE 2: Identify and state the function of each listed component of the power train.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor identifies and describes purpose of each power train component, illustrating disassembly and assembly of parts.

   A. Engine.
   B. Clutch.
   C. Transmission.
   D. Drive shaft.
   E. Differential.

II. Student identifies and describes function of each power train component.

CONTENT TITLE: Engine Systems and Power Train

SUB OBJECTIVE 3: Identify and explain the functions of the five engine system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor identifies parts, explains purposes and traces flow of each engine system.

   A. Cooling.
   B. Lubrication.
   C. Air.
   D. Fuel
   E. Ignition.

II. Students locate parts and explain functions using mock-up engine.

   A. Examine engine parts.
   B. Trace flow of one system.
   C. Participate in discussion of each system.

HEAVY EQUIPMENT

OVERALL OBJECTIVE: The student will demonstrate basic familiarity with the operations of surveying by setting up and aligning a transit, by determining the grade of a pre-existing roadway using a hand level and by identifying, in proper terminology, the points on a roadbed and interpreting the contents of road stakes.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builder 3 & 2, (United States Navy, NAVPERS 10648-F, 1970), GPO D208.11:B68/3/970.

Bureau of Naval Personnel, Equipment Operator 3 & 2, (United States Navy, NAVPERS 10460-F, 1969), GPO D208.11:Eq5/969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Plumb and level
- Degrees, minutes & seconds

Science

- Compass use

Communication Skills

- Making rough drawings
- Dictionary of Occupational Titles
- Manufacturer's literature
- Apprenticeship information

CONTENT TITLE: Surveying

SUB OBJECTIVE 4: Set up and align a transit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates setup and alignment of transit.

A. Protection of equipment.
B. Identify parts of transit and their care.
C. Set up tripod and rough adjust legs.
D. Attach instrument.
E. Attach plumb bob.
F. Adjust legs to center plumb bob over Temporary Bench Mark (TBM).
G. Level instrument and level scope.
H. Loosen base, establish north and remove lens cover.

CONTENT TITLE: Surveying

SUB OBJECTIVE 5: Use a hand level to take a grade.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates use of a hand level for estimating rough grade.

A. Sight through level, on level ground, to obtain eye-level.
B. Level instrument and sight from hub to first grade stake point to take evaluation.

II. Students to use hand level to estimate a rough grade.

A. Stand on level ground and sight on rod to obtain eye-level.
B. Level instrument and sight from hub to first grade stake point to take elevation.

HEAVY EQUIPMENT

CONTENT TITLE: Surveying

SUB OBJECTIVE 6: Identify, with proper terminology, points on a roadbed and interpret content of road stakes.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces basic terms of a road survey, and demonstrates using grade stakes.

   A. Demonstrate reading a rod (Philadelphia leveling).
   B. Discuss symbology of grade stakes.
   C. Demonstrate checking cuts and fills to determine conformance to stakes.

II. Students use road survey equipment on a partially graded roadway.

   A. Read rods.
   B. Use rods to check accuracy of a cut or fill as marked on stakes.

APPENDIX 1

APPENDIX 1

Suggested Tool And Equipment List For Exploration Classes

1	Air compressor
1	Anvil-100 pound
5	Benders, tubing (copper tubing)
1	Blackboard set (wood) triangle, T-square, Straightedge
24	Blades, hacksaw
6	Blocks, sanding, for desk pencil pointers
6	Boards, drafting 24 x 36
2	Braces, carpenter's type
1	Brake, box and pan
1	Break, sheet metal - light duty
3	Breaker, circuit, panel boxes
12	Breakers, 15 amp circuit
4	Brooms, kitchen, push, bench type
6	Brush, drafting-dusting
6	Brushes, masonry type
12	Brushes, 6", 4", 2" paint, nylon bristle
3	Brushes, paste spreading
3	Brushes, wide wallpaper
12	Brushes, wire
4	Buckets, paint (metal)
4	Buckets, 14 qt. plastic or rubber
4	Buckets, steel, 2 gallon calculator, concrete volume (free from local ready mix company)
6	Calipers, drafting
3	Chisel, brick
3 sts	Chisels, wood, plastic handle, 1/4-1" wide blade
4	Clamps, bar
12	C-Clamps, forged steel
6	Clamps, vise grip welding
6	Clamps, hand screw
6	Clamps, spring
4	Copper tubing cutting and flaring kits
6	Cords, alligator clip test, (115V)
4	Cords, 25' extension
6	Curtains, arc-welding - fireproof, for booths
6	Cutters, glass
2	Cutter, pipe (steel) capacity 1/2"-2"

1		Cutter, mechanical tile
1		Cutter, steel rod (bolt breaker)
2		Cylinders, acetylene
2		Cylinders, oxygen
2		Darby, plastering
6	sts	Drafting instruments
1		Drill press
4		Drills, electric hand, 3/8
2	sts	Drill bits, sets masonry, carbide tipped
6	sts	Drill bits for electric drills (steel)
3	sts	Bits, speed boring
6	sts	Bits, high speed twist steel
2	sts	Bits, auger (3/8", 1/2", 5/8", 3/4", 7/8", 1")
6		Faucets, 1/2" outside water
3		First aid kit
6		Files, standard flat-bastard
2		Floats, rubber
1		Folder, bar
3		French curves, small
9	sts	Gloves, welding, leather
12		Goggles, safety, with vinyl side shields
6		Goggles, welding
1		Grinder, pedestal
1		Groovers, seam, set
6		Hammers, chipping, welding
6		Hammers, masonry
2		Hammers, medium size ball pen
2		Hammer, pick
2		Hammers, sledge, 8 pound
12		Hammers, 16 ounce claw, curved wooden handles
2		Hammers, small tack
3		Hammer, half hatchet
3		Mallets, leather, (or plastic)
3		Hawks, plasterers' type
2		Hoes, garden
2		Hoes, mortar mixing
		Hooks, paint bucket (free at local paint store)
3		Knives, linoleum cutting
6		Knife, exacto
6		Knives, putty, assorted sizes
6		Knives, utility
1		Ladders, 16' extension, wooden
2		Ladders, 5' folding, wooden

4		Leroy set (large)
4		Levels, 24" aluminum
4		Levels, masonry, 4' wooden
2		Level, line
6		Lines, self-chalking snap
4		Mitre boxes (hardwood)
4		Mortar boards or pans
3		Nail claw
4		Nail set
2		Nippers, carbide tip tile
6		Oil cans
1		Paint, spray outfit
6		Pencils, mechanical
1		Pipe stand
1	st	Pipe threaders and die set - 1/2"-2"
2		Planes, block
2		Planes, jack
3		Pliers, channel lock, medium
4		Pliers, needle nosed
6		Pliers, slip-joint
6		Pliers, linesmans'
6		Pliers, vise grip
6		Pliers, diagonal wire-cutting
		Pouches, carpenters' nail (free from local lumberyard)
6		Pouches, electricians' leather tool
6		Protractors, 4"
2		Rakes, garden
2	sts	Regulators, sets oxyacetylene (hoses, cutting head, welding tips)
2		Rivoting gun, snap
1		Rod, surveying
3		Rollers, paint, sets with pans, 12"
4		Ruler, 24" steel
6		Rules, bricklayers' folding, spacing and modual markings
12		Rules, 6' folding, wood
6		Rules, 6' or 10' tape, push-button
1		Sander, belt electric
1		Sanders, disc electric
3		Saws, compass, keyhole
2		Saw, coping
3		Saw, 7-1/2" diameter, electric
1		Saw, power hack
3		Saws, hand, cross-cut
4		Sawhorses, wooden

3		Saw, jig, electric
1		Saw, radial, with electric motor
1	st	Scaffolding, sections
6		Scale, engineering-type
3		Scrapers, paint (hand)
3		Scratch awls
6	sts	Screwdrivers, each-common, large, medium, small
6	sts	Screwdrivers, medium Phillips
1		Sharpener, pencil, drafting
4		Snips, sheet metal tin
1		Shear, table mounted metal (capable of cutting 12 guage steel)
1		Shears, paper cutting (4")
1		Shears, pair wallpaper
2		Shovels, long-handled, pointed
2		Shovels, short-handle, pointed
2		Shovels, long-handle, straightedge
1		Soapstone, Arkansas fine
2		Soldering copper
2		Soldering guns, heavy duty, electric
6		Squares, carpenters', steel
4		Squares, combination
3		Squares, tri
2		Squares, sliding T bevel
4		Stapler, (Swingline #400)
6		Stools, drawing table size, Dietzen type (#4505-2M)
		Table, steel cutting, (made by instructor)
		Tables, welding, steel with fire brick insert (made by instructor)
1		Tape, surveying
1		Tape, steel, 100'
2		Template, arrow (Rapi-design) #53
2		Template, large circle (Rapi-design) #140
1		Template, the human figure #22J
1		Template, handy indicator #105C
2		Template, isometric ellipse (Rapi-design) #123
2		Template, large isometric ellipse (Rapi-design) #124
2		Template, landscape (Rapi-design) #715
1		Template, landscape #6784
1		Template, plumbing fixture (elev. view) #37
1		Template, plumbing fixture (plan view) #36
1		Template, stair scale and calculator (Rapi-design) #36
1		Template, window sash #21T
1		Template, window double-hung sash #20T
1		Template, window traverse sash #36T

1	Tamping tool, jitterbug
1 st	Tongs, brick
3	Torch kits, propane
1	Transit
1	Triangle, 8" 45 degree
1	Triangle, 10" 30-60 degree
1	Tripod for instrument, surveying
6	Trowels, bricklayers', pointed
4	Trowel, concrete finishing
4	Trowels, masonry plastering
3	Trowels, notched
3	Trowels, sheetrock (finishing)
1	Trowel, tile glue
1	Tub, mortar mixing
	Tub, quenching, (made by instructor)
3	Vises, 3 1/2" jaw, bench-mounted
3	Vises, pipe
2	Carts, welding
2	Welders, 230 amp AC, Lincoln or equivalent
6	Welding hoods, fibre glass arc, (flip-up viewing plate)
1	Wheelbarrows, garden
1	Wheelbarrows, masonry
4	Wrenches, medium pipe
2	Wrecking bars

APPENDIX 2

APPENDIX 2

Lesson Plan Sample

OVERALL OBJECTIVE	The student will lay out and construct a simple and parallel circuit.
SUB OBJECTIVE	Construct a simple electrical circuit.
TOOLS AND MATERIALS	Romex, pigtail light socket and bulb, solderless terminal connectors, test cord, and linemans' pliers.

I.	Preparation	Chalk board diagram of simple circuit; student handout work sheet.
II.	Presentation	Demonstrate construction of simple circuit stressing safety and correct construction precedures.
III.	Application	Students construct simple circuit.
IV.	Performance and/or other test	

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ABSTRACT: THIS STUDENT MANUAL FOR CAREERS IN THE CONSTRUCTION INDUSTRY PRESENTS EXPLORATORY-LEVEL INFORMATION FOR HIGH SCHOOL STUDENTS. THE FIELD OF CONSTRUCTION COMPRISES SEVEN MAJOR GROUPS WHICH ARE PRESENTED IN THE MANUAL AS THE UNITS: INTRODUCTION TO CAREERS IN CARPENTRY; FINISHING; ENGINEERING, SUPPORT AND MANAGEMENT SERVICES; HEAVY EQUIPMENT; METAL WORKING; ELECTRICITY; AND MASONRY. THE UNITS DESCRIBE THE VARIOUS JOBS INCLUDED IN EACH MAJOR AREA. THIS DOCUMENT SHOULD BE USED IN CONJUNCTION WITH THE INSTRUCTOR'S GUIDE FOR CAREERS IN CONSTRUCTION. (VT 102 405 IN THIS ISSUE). (LJ)

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CAREERS IN CONSTRUCTION

construction industry series
student manual
exploration level

VT 102 406

2

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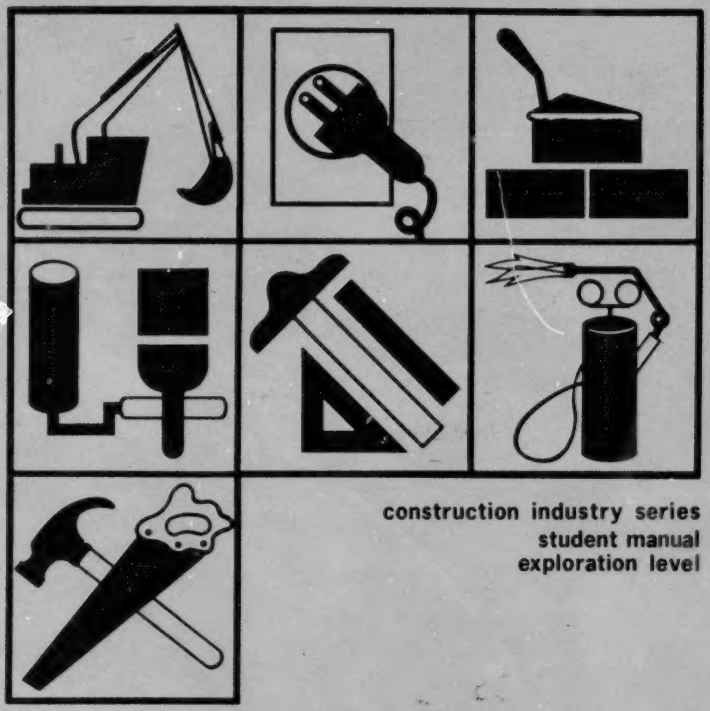
CAREERS IN CONSTRUCTION



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This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

Exploration Level:

Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

Occupational Preparation Level:

Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
Metal - Student Manual
Metal - Instructor's Guide
Electricity - Student Manual
Electricity - Instructor's Guide
Masonry - Student Manual
Masonry - Instructor's Guide

In addition, there is an Articulation Guide designed for these instructional materials in construction.

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IS THERE A CONSTRUCTION CAREER IN YOUR FUTURE?

A person's work is important. It feeds, clothes and houses the family. It provides things that are not essential, but nice — such things as extra vacations and a second car. It also makes a happier, better adjusted individual.

You may wonder why everyone doesn't find a job they like. Often people get sidetracked into jobs that are dull and boring. They can't seem to make the job interesting. They don't develop their productive and creative talents which would make them different from others. They never really experience the excitement of real achievement. So, you can see that trying to decide what kind of job you'd like best is very important.

It has been said that some people pay less attention to choosing a career than they do to selecting a tie. A person might be out of work and run into a friend who says, "Come on down where I work. I think you can get a job. It's not much, but it's steady and the pay is good . . ." So, the person applies and gets the job, but it might be the wrong job.

How do you avoid this kind of trap? You must plan ahead by exploring jobs, seeing what's available and trying to analyze your own likes and dislikes. One of the best ways of exploring jobs is by reading manuals like this one so you'll have basic information about an occupational family.

CAREERS IN CONSTRUCTION

This manual is part of a program called, "Careers in Construction." The program is designed to help you make your decision,

and gives you the chance to explore several career possibilities. You'll have the opportunity to try out some of them. The things you will do in this program are what people actually do on the job. The tasks that have been selected are frequently found in real construction. Doing these things should help you decide whether you like construction-type jobs. You will learn how each job fits in with the others.

As you read this manual and do the exercises, think about what sort of job you want. There are certain things about any job you will need to know. They can be divided into six groups:

1. What does a worker do on this job? Is the work with people or things? Where is the work done?

2. What sorts of things do you like and dislike? What are your abilities? What are your resources?

3. What sort of wages does this worker earn? Are there paid vacations, insurance and retirement benefits?

4. How steady is the work? Are there seasonal layoffs or other slack times?

5. Does the job have a future? Can you be promoted from this job?

6. What training will you need to get this job? Will you need a college or community college degree? Will you have to finish an apprenticeship program?

These are things you should think about when you consider any job.

MAKING THE DECISION

In making a career decision, you should try to match what you know about yourself with the characteristics required by the job. Check the job to see whether it matches your personality, likes, dislikes and abilities. Then think about the plans you will need to make to enter the field. Find out what high school courses you will need in order to enter an apprenticeship, college, or a community college program. You will want to talk to your counselor,

parents, and people who actually do this sort of work. You will need to think about the money it will cost.

If you can, you might try doing some work in construction in the summer. You should experience the physical and mental demands of the job. Talk with people who work in the field. They can tell you what it's like because they will be the people with whom you will work.

Ask yourself these questions, then answer them to see how you might fit best into a job:

Would I have to:	My Answer:
• Work in close, cramped areas?	_____
• Lift heavy loads?	_____
• Work outside in cold, rainy weather?	_____
• Work outside in hot, dusty weather?	_____
• Work a regular 40 hour week?	_____
• Work overtime?	_____
• Think a lot and be creative?	_____

- Work with my hands? _____
- Work with others? _____
- Work alone? _____
- Meet many new people? _____
- Travel out of town excessively? _____
- Work in a large city? _____
- Work in a small town? _____
- Move from place to place on this job? _____
- Wear special protective clothing? _____
- Work with hazards? _____
- Do new, different tasks every day? _____

You know yourself pretty well. How would you rate yourself on these questions?

My Answer:

- What are my abilities? _____
- What do I like to do? _____
- Do I like to work alone or with other people? _____
- Do I like to work outdoors or inside? _____
- Do I like to work with my hands or head? _____
- Would I rather work in a large city or small town? _____
- Would I rather work with a large or small company? _____
- Would I rather work in one place or travel? _____
- Would I rather work a 40 hour week or put in overtime? _____
- Would I rather stay warm and clean or work outside in the cold? _____
- Would I rather not work in a small room? _____
- Would I rather not work at heights? _____
- Would I rather not work underground? _____
- Would I rather not work in bright lights? _____
- Would I rather not work with hot objects? _____
- Would I rather not work with machines and tools? _____

You should consider all these things when you are studying any job, and compare your own personal needs with those of the job. Look for a good match. No job will be perfect in every detail, but some will be better than others.

Other questions that you can ask yourself:

My Answer:

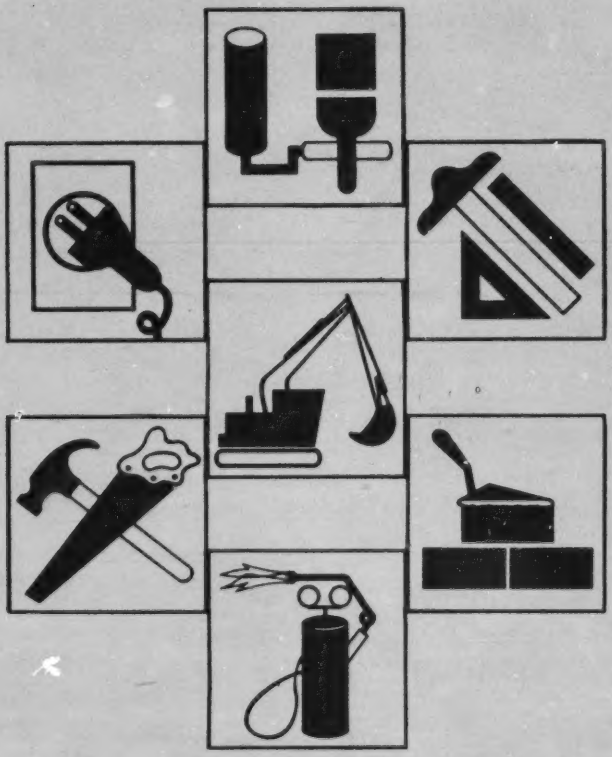
- Are the wages high enough? _____
- Is the work seasonal? _____
- Would I get a regular vacation? _____
- What kinds of retirement plans or insurance programs are available? _____

- How steady is the job? _____
- Are there seasonal layoffs? _____
- Does the work depend on other businesses? _____
- Will this kind of work be changed by technology in the near future? _____
- Can I budget my money well enough to handle long periods of time without working? _____
- Do I want to work regularly all the time? _____
- Does the job have a future? _____
- Can I be promoted to a more responsible position? _____
- Will the field grow over the years or be smaller? _____
- Is it a field I can go into business for myself? _____
- What sort of training is required? _____
- Does the work have an apprenticeship program? _____
- Does it require a college degree or community college study? _____
- Is the preparation hard? _____
- What special skills are required to do the work? _____
- Is any on-the-job training offered? _____
- Will the employer help pay for courses and other costs of education? _____

In order to decide about a job area, you need information about the work, earnings, training programs, training opportunities and what you must do to qualify for this training. Talk to your teacher or counselor and write to the various trade associations which are

listed at the end of each section of this manual for more information. The associations will advise you about working conditions and apprenticeship and community college training programs which will be useful.

Experts tell us that most people will change careers three or more times in their lifetime. Technology is changing very rapidly and people have to make adjustments in their work, so it's very important to remember *how* to make these decisions. Although you may be interested in a general field, it is unlikely you know all the jobs which are available within that field. Studying as many jobs as possible will show how they fit together. You can do the work you choose better if you understand how jobs relate to a chosen career.



JOBS IN CONSTRUCTION

In this manual you will learn about jobs in the field of construction. These jobs are divided into seven major groups. Within each group are many different jobs. The groups are:

WOOD — Jobs in which a worker builds things with wood.

METAL — Jobs in which workers shape or build things from metal.

MASONRY — Jobs where workers build things with brick, concrete blocks, cement, tile or terrazzo.

FINISHING — A broad group of jobs or occupations where workers decorate or finish a building, including painting, glazing, floor covering, landscaping, insulating and roofing.

ELECTRICITY — Jobs where workers install wiring systems, electrical fixtures and electrical equipment.

ENGINEERING, SUPPORT AND MANAGEMENT SERVICES — Jobs that require organizing and directing the efforts of others. These jobs are done by surveyors, estimators, testers and inspectors.

HEAVY EQUIPMENT — Jobs that require operating and maintaining cranes, bulldozers, graders and other equipment in building.

All of these jobs will be explored in this book. If you choose a career in construction, you will be entering an exciting, vital and ever changing field. Welcome! We hope you like it!

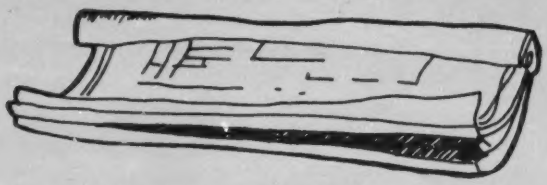
INTRODUCTION TO CAREERS IN CARPENTRY

All the occupations that deal with cutting, fitting and assembling wood or wood products are classified as *carpentry*.

Recently, carpenters have begun to specialize in different types of carpentry. One carpenter may prefer installing hardwood floors to other types of carpentry. Another may like to put up frames of buildings and become a framing carpenter. Still another may specialize in cabinet making or one of the numerous other jobs that fit into carpentry.

The woodworking field is very broad and you will have a wide range of jobs to consider. You might decide that someday you want to be a carpenter, foreman, superintendent, vice president or independent contractor. If you were to become a construction foreman, you would be working more with your mind and with people, and less with your hands.

As you look at various carpentry specialities (framing, roofing, forming, etc.) you'll notice many similarities among them because they are related occupations. You'll also see many small differences which will help you decide the jobs you want to secure information about. If you explore these jobs thoroughly, you will eventually gain enough knowledge about them to feel confident in making a decision. Remember: The more information you have about a job the better your decision will be about that career.



FORMING AND ROOFING CARPENTERS

If you were a carpenter on a forming and framing job, you would use a set of blueprints and work with your foreman to lay out the foundation. The words *lay out* mean the things you would do at the job site before starting actual construction. This includes getting the building site ready and getting the needed tools and materials together. To beg the lay out, you would use the blueprints to locate where the building is to be constructed on the lot. This is done by measuring distances from reference points shown on the blueprints, usually an established road, street or property line and a reference point made for you by a surveyor. That point is called the surveyor's *bench mark*.

An Engineer's Transit (leveling instrument) is used to find out where the corners of the building will be and whether the location will need to be leveled. The building is staked out at each corner.

Boards on posts are put up 3 or 4 feet outside each corner stake so that accurate positions can be maintained if the stake itself must be removed to level the site. After these boards have been put into place, a final check is made to be sure that the layout is both square and accurate according to the blueprints.

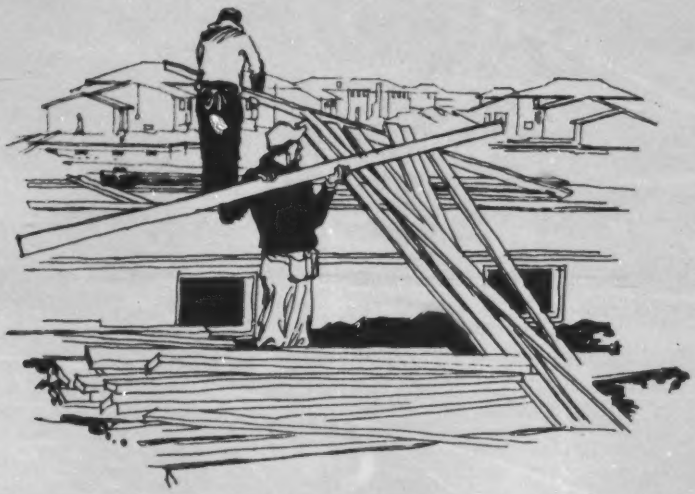
After staking out the building, the builder prepares the site for the foundation, often using concrete slabs. A carpenter needs special knowledge to build concrete forms, and is known as a *forming carpenter.*

Many forming carpenters work for large companies which only build concrete structures such as bridges. These forms are built to hold and support the semi-liquid concrete until it is hardened. After the forms are built, the reinforcement steel and plumbing are added and then the concrete is poured.

After concrete workers pour the foundation, carpenters put up the framing. In working for a large construction company, you might specialize by becoming a framing carpenter and only do framing work.The frame of a building is the wooden form con-

structed to support the finished sections of the structure. You've probably noticed houses being constructed which have many vertical boards being put up at intervals to support the walls and siding. You've probably seen rafters in place where a roof is to be built. These are part of a frame. Just as your skeleton supports your body, the framework of a building supports the rest of the structure.

The first step in framing is to put up the sills. Then come the floor joists. Sills support the main beams (girders) of a building. Floor joists make up the frame upon which the subflooring or flooring is nailed. On a concrete slab, a floor sole plate is put directly on the concrete foundation around the outside and where the partition walls will be.



Framing the walls is the next step. The wall framing is set on the floor sole plate and holds up the top plate and all of the weight of the upper part of the building. The wall framing also provides a framework for nailing siding on the outside, and sheetrock (lathing) and plaster on the inside.

After framing the walls and partitions you are ready to put up the ceiling and roof. The roof must be sloped enough to shed water and strong enough to withstand the weight of snow and ice. It should be constructed to withstand high winds.

Roof framing is one of the most difficult kinds of carpentry. The roofing carpenter cuts and puts rafters into place. Sheathing (plywood sheets) are nailed onto the rafters. Roofers add the roofing to the sheathing.

It is not easy to learn what the correct angles are for cutting rafters, nor is it easy to cut them correctly. Many contractors now have their rafters put together at the contractor's yard and hauled by truck or trailer to the job site. These rafters are placed and braced until the sheathing can be nailed into place. As a carpenter, you might, therefore, work inside a factory. A framing carpenter also erects scaffolding or platforms, and carpenters stand on these while they work. This is one of the many skills needed by a carpenter.

ROOFING CARPENTERS

Specialists known as roofers put on roofing material called for in the specifications. A flooring carpenter will put in certain floors such as hardwood floors. Still other workers add floor coverings such as tile, vinyl or carpet. The interior walls are put up by carpenters, if they are made of wood or other paneling. Other craftsmen such as drywall installers (sheetrock), plasterers and tile setters put up the interior walls.

Here are some of the things that are done in roofing:

- put composition roofing, cedar, slate or tile roofing on buildings,
- waterproof and dampproof walls and other building surfaces,
- repair and maintain existing roofs.

If you were to install composition roofing, you would first cover the sheathing with strips of asphalt or felt. Then, if you were going to make a built-up roof, you would coat the strips of felt or asphalt with coal tar. Before the last of many coats of tar dried and hardened, you'd cover the roof with a thin layer of gravel to help protect the roofing materials from the weather.

Composition shingles or composition roll roofing are put directly over the felt and are nailed into place with roofing nails. Metal, tile and slate roofs are more expensive than composition roofs and are not used as much.

If your job included waterproofing and dampproofing other structures such as masonry, concrete walls and swimming pools, you'd first prepare the surfaces by removing any rough material. After preparing the surface, you would paint on a coat of liquid waterproofing with a brush or a sprayer. Sometimes, you'd nail waterproofing fabric to the surface and then treat it with waterproofing material. Dampproofing is done by spraying a coat of hot tar or asphalt on the surface.

TRIM CARPENTERS

Another part of the woodworking construction field is working with trimming and siding. Trimming and siding carpenters install siding such as wood, shingle or asbestos, and then do the exterior and interior trimming. Trimming consists of all the lightweight wooden parts which help a building look finished, including cornices, doors and door frames, windows, window frames and window sashes, porch trim, kitchen cabinets, linen closets, finish hardware, etc.

Kitchen cabinets may be constructed elsewhere, brought to the site, and bolted into place. This is called prefabrication. Increased prefabrication and other major changes will have a great effect upon the construction industry. More prefabricated items are being used at a fast rate, and plastics and metals are in heavy use.

BUILDING CONTRACTOR

Many people have dreams of someday being the "boss." In the construction industry, the boss is the building contractor. This person has the responsibility for getting a construction job done on time and for a certain amount of money. Sounds simple? Let's take a careful look at what is involved.

The building contractor starts the job right after the first plans have been made. After carefully examining the drawings and specifications for a certain job, the contractor prepares and submits a bid. A bid is a guess as to how much it will cost to construct a building.

If the bid is accepted, the contractor signs an agreement with the owner to complete the job on time. Materials are purchased, workers hired and sub-contracts let. Plans are made for the progress of the work, time schedules are set for the various workers, and a close watch is kept to be sure that the work being done follows the requirements of the building blueprints and specifications.

Very few construction workers start as building contractors. A building contractor must know the construction field very well and have good business sense. This person must be able to figure costs accurately so that bids will be high enough to make a profit, but low enough to be accepted. Work must be directed to others and information conveyed on what needs to be done and how it should be completed.

Many contractors have started by becoming apprentices in one of the skilled building crafts, often carpentry. After becoming master craftsmen in one trade, the next step begins in sub-contracting and then gradually working into general contracting. Others attend technical schools which offer instruction in construction materials and methods, architectural and engineering technology and estimating. These programs usually run from one to four years. Other building contractors are college educated engineers or architects. However, on-the-job experience is the most valuable part of contracting.

All building contractors must understand construction financing, accounting and business methods; cost estimating, blueprints and architectural drawings; the technical language used in specifications; and the legal language used in contracts and building codes. The person with a technical school or college education often starts out as an estimator, specifications writer, materials buyer or salesperson for a construction company. Some start in the business office of a construction company and learn that phase of the work first.

If you are interested in contracting, you should study algebra, geometry, business math, bookkeeping, business English, typing, mechanical drawing, drafting and blueprint reading.

Building contractors work long hours. They frequently work seven days a week, and a 60 hour week is not unusual.

There is always an opportunity for the small, independent operator to compete in construction jobs. Starting a small firm does not require a large amount of money, and the contractor can usually get credit for the materials purchased. Because it is easy to enter the field, there is a lot of competition for small jobs.

GENERAL CHARACTERISTICS OF WOODWORKING OCCUPATIONS

The occupations discussed above should give an idea of the work of a woodworking person. It also shows there are enough different kinds of jobs available that there probably is one for you if you like woodworking. You can tell from the many types that the job you seek can be almost anything you want it to be. You can work on a job where you use your head or stick with a job where you use your hands. You can work into a job where you deal with many people, or just a few.

The variety you get in your work will usually depend on the type of contractor you work for. Generally speaking, the smaller the contractor the wider range of duties you are likely to perform. On the other hand, the larger the company the more likely you are to specialize. The size of town will make a difference. If you work in a small town, you will probably do all kinds of carpentry work, but in a city you'll probably specialize.

In looking at the construction industry over a long period, most workers pick out a broad field and stay with it. Some stay with residential construction, some with commercial construction. Others go into bridge building, highway construction or industrial maintenance. A few people work in ship building, dock and pier construction and mining. Some do maintenance work in factories, hotels, office buildings or for government agencies. Still others may work on alteration, remodeling or repair. The possibilities are endless. In fact, there are over 800,000 carpenters in the United States today and that figure is expected to increase to 1,000,000 later in the 1970's.

Special tools and equipment are part of the industry, both hand and power. Hand tools include hammers, saws, chisels, screwdrivers and planes. The power tools used are saws, drills and in some cases rivet guns. There are a great many new power tools entering the field now, from nailing guns to gluing machines. You probably will be expected to learn how to use them.

You should wear some type of safety gear on every job. It may be a hard hat or goggles if you are using a saw. You must follow safety regulations at all times and become safety conscious. With the use of today's high powered tools, it is extremely important to work safely at all times.

If you become a skilled person in the woodworking trades, you will be doing physical labor and will often work outdoors. This is appealing to some people if it's good weather, but remember that it's usually hot in summer, cold in winter and there is often no work that can be done in rainy seasons.

Most carpenters work daytime hours. In rush seasons you might work 60 hours a week or more. Sometimes you will travel to and from a job site. This makes your work day longer, but your employer may pay you for the extra time. When you do work long days during the rush season, you are ordinarily paid overtime for all work over 40 hours a week.

Woodworking occupations are not considered too hazardous. Naturally, you must be careful when using power tools, and be cautious of sharp and rough materials. If you plan to be a roofer you should be in good physical condition, have a good sense of balance, and not have a fear of heights.

Salaries differ among types of jobs in the field and among different geographical locations. Your instructor can give you more up-to-date information about salaries in your area. The hourly wages for your location may be quite high. If they are, that is good, but keep these questions in mind: Is the work seasonal in your locality and will there be many days that you cannot work due to cold or rainy weather? You will need to convert the hourly wage to a probable annual salary before you know if it's really as good as it may sound.

Depending upon what phase of the industry you work in and what size of contractor you work for, you may or may not get an

annual vacation. You will want to inquire about such benefits as vacations, insurance provisions and retirement plans, when you consider going to work for a company. Most small contractors will not be able to offer many benefits, although this can be offset by higher wages. If you want security, you may want to take a job paying a little less with a larger contractor.

How do you go about getting into woodworking occupations? You've made a good start by reading this booklet and participating in the construction program. Other ways are through:

- An apprenticeship program.
- On-the-job experience.
- Correspondence courses.
- Trade school education.
- Community college programs.

Further information can be obtained by writing:

- Associated General Contractors of America
  20th and E St., N.W.
  Washington, D.C. 20036
- National Association of Home Builders
  15th and M Street, N.W.
  Washington, D.C. 20005
- Building Construction
  5 South Wabash Avenue
  Chicago, Illinois 60603

- National Roofing Contractors Association
  1515 North Harlem Avenue
  Oak Park, Illinois 60302
- United Slate, Tile and Composition Roofers, Damp and Waterproof Workers Association
  1125 17th Street, N.W.
  Washington, D.C. 20036
- The United Brotherhood of Carpenters and Joiners of America
  101 Constitution Avenue, N.W.
  Washington, D.C. 20001

INTRODUCTION TO CAREERS IN FINISHING

Finishing occupations include painting and wall covering, insulating and asbestos, glass and glazing, drywall application, floor covering and landscaping. People who do finishing work of one kind or another range from those who are self-employed to those who work for large construction firms, home builders or interior designers. Finishers do both remodeling and new construction. Although there is more work in urban areas than in small communities, even the smallest community needs painters, paperhangers and others in the field. Let's take a look at each of the occupations included in this group and see what is involved.

PAINTING AND PAPERHANGING

Painters and paperhangers apply finishes to walls and other building surfaces. The painter applies coats of paint, varnish, stains, enamel or lacquer to interior and exterior surfaces for the purpose of decoration and protection. The paperhanger, though, covers interior walls and ceilings with decorative wallpaper, fabric, vinyl or other materials.

The painter must first prepare the surface to be painted. The painter removes any loose paint by scraping, filling nailing holes and cracks, sandpapering rough spots and brushing off dust. A new surface must be primed with a sealer to give the paint a suitable base. Paint may be used on wood, steel or clay products.

A painter must know how to use a brush, spray gun or roller so that paint can be applied thoroughly, uniformly and rapidly to any kind of surface. Painters need to know how to mix paints and match colors, and know the features of common types of paint.

Before painting high surfaces, painters usually set up raised working platforms called scaffolds. A person who is afraid of heights would probably be limited in the kinds of painting jobs and might find another occupation more suitable.

Allergies are another problem which painters may encounter. Fumes from paint and varnish, turpentine and lacquer bother some people and can cause lung or skin problems. In addition, painters must bend, climb and stand for long periods of time and much of their work is done with their arms raised overhead.

Like painters, the paperhanger first prepares the surface. If it is a new surface, sizing is applied which makes plaster less porous so that paper will stick better. If the paperhanger is redecorating a room or house, the surface is prepared by removing old paper and by patching holes or uneven places in the plaster surface.

After preparing the surface, the paperhanger carefully measures the area to be covered, cuts a length from the roll of wallpaper and positions the patterns so that they will match at the ceiling and baseboard. The paperhanger mixes an adhesive paste and applies it to the back side of the paper. The paper is placed on the wall and smoothed with a dry brush.

Painters and paperhangers may work for contractors on new construction or be hired by contractors to do repair, alteration or remodeling on existing structures. Maintenance painters and paperers often do work for hotels, office buildings, shipyards, utility companies, manufacturing firms, schools and other groups.

Eventually, new kinds of paint that will be easier to apply may limit the number of jobs available for painters. Other new paints will last longer than most of those used today. In addition, many items which used to be painted at the construction site now come from the factory with a prime coat and often with a final coat. Aluminum building products, which require no painting at all, are being used more frequently.

One way to learn about being a painter or paperhanger is to complete a three-year apprenticeship program. In this program, you will learn to use and care for tools, equipment and materials. You will learn how to mix and match paints, prepare working areas and surfaces, set up and move scaffolding and apply various kinds of interior and exterior materials. In classes, you will study paint chemistry and color harmony and learn how to make, mix and match paints of various kinds. You will learn how to estimate costs and study the relationship between painting, paperhanging and the other building trades.

Wages for painters and paperhangers are slightly less than those for other building people. Wages vary widely from one section of the country to another and between rural and urban areas. Many painters and paperhangers belong to the International Brotherhood of Painters and Allied Trades.

You can get more information by writing:

- International Brotherhood of Painters and Allied Trades
  1925 K Street, N.W.
  Washington, D.C. 20006
- Painting and Decorating Contractors Association of America
  2625 West Peterson Avenue
  Chicago, Illinois 60645

ASBESTOS AND INSULATION WORK

Asbestos and insulation workers determine insulation requirements, select the right insulating material and install insulation so that it will work effectively. Insulation holds in heat and saves fuel. In refrigeration systems, insulation keeps heat out and holds down loud noise.

There are several ways to install insulating materials. These include pasting, wiring, taping, stud-welding, spraying, nailing, stapling and plastering.

Asbestos and insulating workers use power saws and hand tools as trowels, brushes, scissors, sewing palms, heavy-duty needles, hammers, saws, pliers and stud-welding guns.

Most insulators work for insulation contractors in new construction. Others do alteration or maintenance on insulated pipework in chemical plants, oil refineries, atomic energy installations and other industrial plants. Some cold storage facilities also employ insulation workers for maintenance work.

Training programs for asbestos and insulating workers are called improvership programs. They take four years and are very similar to apprenticeship programs in other building trades. Trainees must be between the ages of 18 and 30 and in good physical shape. There is a specified period of on-the-job training in which

they learn to work with insulating materials and to handle the tools of the trade. When they finish an improvership program, trainees must pass an examination to demonstrate their knowledge.

Insulation workers spend most of the work day on their feet — standing, bending, stooping and squatting. They sometimes must work from ladders and in tight, cramped places. Removing old insulation is an extremely dusty, dirty job, and some people find that they are allergic to the materials or dust.

Wages for insulation workers are slightly higher than average for other workers in the building trades.

More information can be obtained by writing:

- International Association of Heat and Frost Insulators and Asbestos Workers
  1300 Connecticut Avenue, N.W.
  Washington, D.C. 20036
- The Insulation Board Institute
  111 West Washington Street
  Chicago, Illinois 60602
- National Insulation Contractors Association
  8630 Fenton Street, Suite 508
  Silver Spring, Maryland 20910

GLAZIERS

Glaziers work with glass. They are experts in cutting, fitting and installing plate glass items. They work for glazing contractors who install glass on new construction, do alteration and remodeling work and replace broken glass.

Some glaziers work for businesses who do their own construction work. Other glaziers work in factories where they install glass in sashes, doors, mirror frames, partitions, furniture, ships or automobiles.

Glaziers are often hired to install all kinds of structural glass, inside and outside, including shower doors, bathtub enclosures, mirrors, automatic doors and fabricated units made of glass.

Glaziers use power tools as cutters and grinders and hand tools as glass cutters and putty knives.

The employment outlook is very good. Commercial buildings are using more glass, and some buildings are going up with almost total glass exteriors. Putting up this kind of building will keep many glaziers fully employed in the future.

A three-year apprenticeship program is one way to become a glazier. Apprenticeship applicants should be between the ages of 18 and 26 and have a high school diploma. During the apprenticeship program you will learn how to use and handle tools, machines and materials of the trade, safety measures and first aid, how to read specifications and blueprints and how to erect scaffolding. You will practice glazing wood and metal sashes in doors, windows, partitions and other openings, and the setting and replacement of all kinds of store front installations, structural glass, mirrors, showcases, partitions, fixtures and automobile glass.

You can find out more by writing:

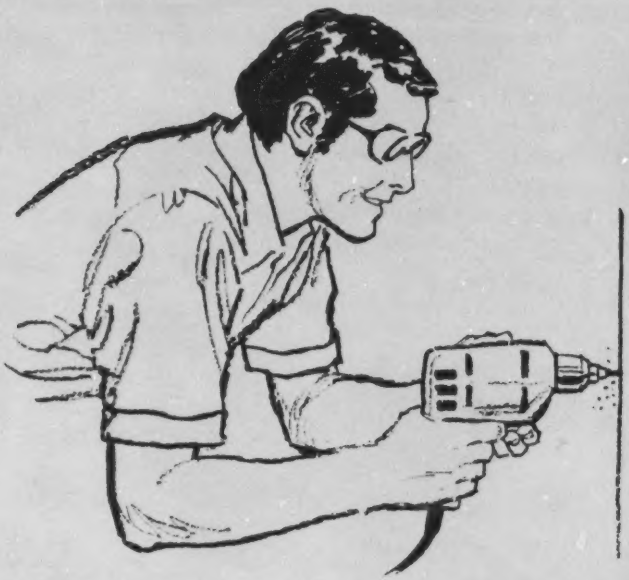
- International Brotherhood of Painters and Allied Trades
  1925 K Street, N.W.
  Washington, D.C. 20006
- Flat Glass Marketing Association
  1325 Topeka Avenue
  Topeka, Kansas 66612

DRYWALL APPLICATION

Drywall applicators do the following things:

- Handle wallboard
- Score and snap the wallboard
- Prepare sidewall and ceilings
- Cut-out openings
- Bed joints
- Secure the sideboard
- Tape, float and finish joints
- Waterproof the board
- Apply and finish various kinds of walls.

Skilled applicators often estimate material needs for new construction or repair work. In working for a large contractor you might become a drywall applicator, a nailer, a taper, a sander, a taping machine operator or a modular drywall installer.



One job which is becoming more important in drywall work is modular wall installation. Two different groups of workers are usually involved in this work. One group of workers construct the wall, apply wallboard and nearly finish the modular wall panels at the factory. Another group of workers install the completed wall at the construction site. This type of construction is very common, particularly in large cities and industrial areas.

Experienced drywall applicators may become estimators or managers. In most cases these jobs require extra training and experience. Many estimators and managers work directly for an industrial firm or manufacturer.

Although you may be able to find a job applying drywall as soon as you complete high school, advanced training in the field is highly desirable. One of the best ways is by on-the-job training with an independent contractor. In addition to informal training, there are formal apprenticeship programs. There are schools which offer training in drywall application in every State. These schools include community colleges, vocational-technical schools

and local trade schools. During the training period, you will learn to use the materials and tools of the trade safely and efficiently and spend a great deal of time actually working with drywall.

Drywall application is a fairly safe occupation. There are dangers including from scaffolding, injuries from careless use of tools and back from lifting heavy items improperly. The entire construction industry is becoming more aware of safety hazards, and the construction worker is much safer now than a few years ago.

More information may be obtained by writing:

- Gypsum Association
  201 North Wells Street
  Chicago, Illinois 60606
- National Gypsum Company
  325 Delaware Avenue
  Buffalo, New York 14202
- Gypsum Drywall Contractors International
  2010 Massachusetts Avenue, N.W.
  Suite 600
  Washington, D.C. 20036

FLOOR COVERING INSTALLERS

Floor covering installers install, replace and repair floor coverings as resilient tile, linoleum, vinyl sheet materials and carpeting. The coverings are installed over wood, concrete, metal or other subfloors.

After preparing the surface, the installer carefully measures and marks off the floor, based on the floor covering plan. The installer then cuts and fits the flooring material, applies the adhesive and installs the floor covering, being careful to get a good fit.

The carpet installer first inspects the surface to be covered and lays out the job, wasting as little material as possible. The expected traffic patterns must be known so that the carpet will be preserved as long as possible.

The installer next lays out padding, laying it within the framework of a tackless strip. The carpet is laid out, stretched and fixed on the strip. Finally, the installer uses a special roller to bind seam markings where sections of the carpet are joined.

Most floor covering installers specialize in either carpet or resilient floor coverings, although some work with either kind of covering. Tools used include hammers, pry bars, shears and other cutting devices, measuring and marking tools, notched adhesive trowels, carpet stretching devices and floor rollers.

Floor covering installers usually work for flooring contractors, floor covering retailers, furniture and department stores and home alteration and repair contractors. Workers in this field are concentrated in urban areas where a large amount of commercial and residential building takes place.

Training for this field could include a three to four year program with on-the-job training and related classroom instruction. Applicants should be between the ages of 17 and 30, have at least average physical strength, above average manual dexterity and preferably a high school education. Because most of the work performed is done on a customer's property, it is especially important that these workers have a neat appearance and a pleasing manner.

Many workers have learned to cover floors by working as informal trainees or laborers and observing or being taught by experienced workers. Some manufacturers train people to install their particular brand of floor covering materials. Skilled floor covering installers may become foremen or installation managers for a large firm. Some may become salesmen or estimators for firms, and others may even form their own companies.

The floor covering installers' wages vary widely from one area of the country to another and from one firm to another. Since most of these workers do not belong to a union, there is not as much standardization of wages as seen in other construction fields.

Working conditions for floor covering installers are generally good. They work regular hours, except in unusual situations

where there is a rush job, and work is not ordinarily affected by the weather since it is performed indoors. The work is not considered hazardous, although there is a great deal of kneeling and occasionally workers suffer back injuries from lifting.

Further information may be obtained by writing:

- Carpet and Rug Institute
  P.O. Box 2048
  Dalton, Georgia 30720
- Asphalt and Vinyl Asbestos Tile Institute
  101 Park Avenue
  New York, New York 10017
- Resilient Tile Institute
  101 Park Avenue
  New York, New York 10017

LANDSCAPING

The work of the landscape architect or landscape gardener is entirely different from that of any other craftsman. This work is concerned with the ground around a building, rather than the building itself, and the work is truly a finishing touch. Landscape architects plan, design and arrange outdoor areas for their client's use and enjoyment.

A professional career in landscape architecture usually involves completion of four years of college with a major in landscape architecture, but there are a number of related occupations which do not require a college education. A number of opportunities exist for such skilled workers as landscape gardeners, nurserymen, tree pruners and groundkeepers. Working for a private employer is a good way to enter this field since past experience is usually not required for unskilled or semi-skilled jobs in landscaping-related jobs while working and progressing in earning power.

Most landscape architects are either self-employed or work for other landscape architects in private firms and handle a variety of assignments. Some firms specialize in projects such as parks and playgrounds, hotels and resorts, shopping centers, roads or public housing. Some landscape architects work for government agencies involved in public housing, city planning, urban renewal, highways or parks and recreational areas. A few landscape architects work for engineering firms or for landscape contractors.

Emphasis on ecology is also a factor in the employment of landscape architects, because the general public is more concerned than ever before with wise and efficient use of land.

College entrance requirements for landscape architecture are generally the same as those for liberal arts. All schools recommend that the student have a good foundation in mechanical drawing and more courses in art and mathematics than are normally required for high school graduation. The course of study in college will include a number of courses in design plus courses in civil engineering and horticulture. Courses in English, the social sciences and mathematics are required of all students.

A new college graduate with a degree in landscape architecture will usually begin as a junior draftsman. It takes two or three years to become registered as a landscape architect and be qualified to carry through a design from start to finish. With a few more years of experience the architect may become a partner in the firm or may open a firm.

It is not unusual for an experienced landscape architect to make $25,000 or more a year. Landscape architects in independent practice often earn more than salaried employees, but their earnings may vary considerably from year to year when employees can count on a regular salary.

Landscape architects employed by government or private firms generally work regular hours, although they may be called on to work overtime during seasonal rush periods. Those who are self-employed often work more than a 40 hour week.

Additional information may be obtained by writing:

- American Society of Landscape Architecture, Inc.
  1750 Old Meadow Road
  McLean, Virginia 22101
- American Institute of Landscape Architects
  6810 North 2nd Place
  Phoenix, Arizona 85012

INTRODUCTION TO CAREERS IN ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

Almost every aspect of our daily lives is affected by the activities of the construction industry. Products of this industry include the house or apartment you live in, the school you attend, and if you hold a job, the building where you work. The roads and streets you travel on to get to school and to work are also products of this industry.

Construction jobs are usually classified in three major groups — structural, finishing and mechanical. Those jobs that are mainly concerned with structural work include carpenters, bricklayers, cement masons, structural iron workers. Finishing work includes plasterers, tile setters, painters, roofers, floor covering installers. Mechanical work includes occupations as plumbers, construction electricians, sheet-metal workers.

Construction jobs typically employ several levels of workers. First is the foreman and the journeymen (craftsmen) who have a high level of skill and a thorough knowledge of construction operations. Between the upper levels of a company, where decisions are made, and the foreman/journeyman level, a group of jobs known as engineering, support and management services are found.

EXAMPLES OF ENGINEERING, SUPPORT AND MANAGEMENT WORK

Before any structure is built, a complete set of detailed drawings that give the exact dimensions and specifications of the structure and all of its parts is drawn. The workers who draw these plans are *draftsmen*. Different draftsmen specialize in different areas of work. Draftsmen are an example of engineering and support personnel.

After the plans are drawn someone must study them carefully and *estimate* what it will cost to build the structure. This estimate is used to make a bid. If the bid is accepted the construction company gets a contract to build. Among other things, the accuracy of that bid will determine whether the contractor makes a profit on the job. Estimating is another construction support service.

The accurate placement of the structure upon a lot is the job of the surveyor.

Once a bid is accepted and a contract is made, the contractor must see to it that the proper building materials arrive on time.

The person who ensures that materials arrive at the site in correct order and on time is called an *expediter*. Expediting is a support service.

The quality of materials and the quality of workmanship make up the quality of the finished job. The person who tests and inspects the materials used on a project, or inspects the plumbing and electrical work as they are done, is called an *inspector*. Testing and inspecting is also a support service.

The *materials distributor* makes sure the contractor received good construction materials as cheaply and quickly as possible. Material distributors have the widest range of responsibilities and jobs of all the support services. The truck driver who delivers construction materials from where they were made and the retail salesperson who sells a pound of nails at the local lumber yard are both in the field of material distribution.

DRAFTSMEN

Draftsmen take the ideas, rough drawings, specifications and calculations of engineers, architects and designers and turn these into working plans. When they do this, they are often asked to calculate the strength, reliability and cost of materials and to tell exactly what materials are to be used on a particular project. The "tools of the trade" for draftsmen include compasses, dividers, protractors, templates, triangles, engineering handbooks, mathematical tables and slide rules.

Draftsmen are classified according to the work they do:

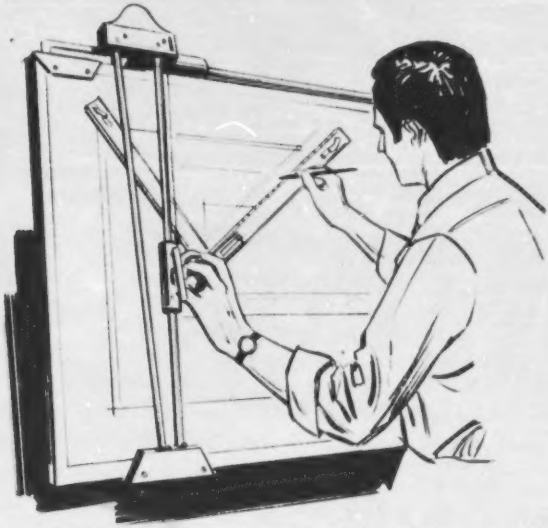
Senior draftsmen use information provided by engineers and architects to prepare layouts, or scale drawings of the object or building to be built.

Detailers draw each part shown on the layout, giving dimensions, materials and other information necessary to make the drawing clear and complete.

Checkers examine drawings for errors in arithmetic or in drawing dimensions or specifications.

Tracers make minor corrections and prepare drawings for reproduction.

Another way that draftsmen are classified is by the types of drawings they make. For example, there are electrical, electronic, aeronautical, structural and architectural draftsmen.



The largest employers of draftsmen are manufacturers who make machinery, electrical equipment, transportation equipment and fabricated metal products. Engineering and architectural consulting firms and construction companies also use many draftsmen. Also a considerable number of draftsmen are employed by the government at Federal, State or local levels.

There will be more and more jobs for draftsmen, because of complex design problems of modern industry. Eventually, photoreproduction of drawings, the expanding use of electronic drafting equipment and computers will eliminate some routine tasks. Future drafting jobs will go to people with the best training.

A high school student who wants to be a draftsman should take these courses while in school: Math, physics, chemistry, drafting and any industrial education that is offered.

Draftsmen who receive education beyond the high school level, before starting to work, usually begin as junior draftsmen. They can expect to be promoted faster than those who lack this training. Draftsmen can take additional training courses at technical institutes, community colleges, vocational and technical schools, through correspondence courses, or three to four-year formal apprenticeship programs. Technical schools offer courses in advanced drafting, structural design, strength of materials and physical metallurgy.

Senior Draftsmen who are skilled in working with other people may become supervisors. Others who are particularly talented may start businesses of their own as independent designers.

Draftsmen need the ability to visualize in three dimensions. A steady and well-coordinated hand is important too. Most of all, the prospective draftsman needs to be patient, careful and willing to spend a lot of time on detail work. Accuracy, neatness and reasonable speed will net the best jobs.

Draftsmen are white-collar workers. They work indoors, in clean, well-lighted surroundings, primarily with professionals. Except under unusual circumstances, they work regular hours.

You may find out more by writing:

- American Institute for Design and Drafting
  3119 Price Road
  Bartlesville, Oklahoma 74003
- American Federation of Technical Engineers
  1126 16th Street, N.W.
  Washington, D.C. 20036

ESTIMATOR

Not too long ago most people, even contractors, thought estimators merely added up the cost of a list of materials and labor required to construct a building. Contractors now see that estimating is very complex and that estimators furnish very useful information to construction companies.

Rough Estimate

An estimator first makes a *rough estimate* before the working drawings of a proposed building are completed. His estimate at this stage is only an approximation.

Preliminary Estimate

Second, *preliminary estimates* are figured. They are more carefully figured than rough estimates. They are calculated when the

contractor wants to figure building costs more precisely. Preliminary estimates consider such things as past experience with this type of building, the costs of the construction company and new equipment purchases required.

Intermediate Estimate

Later in the planning stage, an estimator will make what is known as an *intermediate estimate*. Intermediate estimates are more accurate than preliminary or rough estimates, but still are not accurate enough for a bid proposal. They are prepared like preliminary estimates, but are more carefully done. Intermediate estimates are useful, because they calculate materials and labor costs in light of similar costs on previous jobs. From this information the estimator can figure payroll needs and material costs at each stage of construction.

Final Estimate

The *final estimate* is figured when a complete set of working plans and specs is available and is the one upon which a company will base its bid. Once that commitment is made, the firm must honor it. If the estimate is too high for the job, the company may not win the contract; if it is too low, the firm will lose money in meeting it.

When preparing the final estimates, estimators break the costs down into three broad areas. These areas include the labor costs, the material costs and the equipment operating costs. After each of these costs is figured, the estimator adds contingency costs, overhead costs and a percentage of the total to be used for profit.

To calculate each of these costs, the expeditor figures the amount of time it will take to finish each phase of the project and includes allowances for overtime if it will be needed.

The estimator makes a list of different kinds of work that must be done in each part of the project. One list might have all the site preparation jobs such as clearing, leveling and so on. Another list might have all the tasks for laying the foundation as forming, tying steel, etc. It is very important that the lists be checked and double checked to make sure that nothing is overlooked.

An estimator's job requires very little physical exertion. If you prefer organized tasks which are technical, then you may like estimating. Estimators normally work a 40 hour week, but you may have to work nights or weekends to meet a deadline. You should remember that those people who work a 40 hour week often have a comfortable living, but it is usually the ones who are willing to work 50 or more hours per week who become the experts in their field.

Your salary will be influenced by how valuable you can be to your company. As you gain experience you'll be worth more and you'll be paid more. Salaries vary in different parts of the country. One general rule to remember is that in places where you make more, the cost of living is usually higher. Your instructor and your counselor can provide information about present salaries in your locality.

EXPEDITER

An expediter makes sure that the right building materials are delivered at the job site at the right time. No matter how good the superintendent's plan is, if the expediter has not purchased the proper building materials and had them delivered to the job site at

the right time, the work simply cannot be done. The expediter's job, therefore, is extremely important.

As an expediter, you will ensure that the materials are waiting for the workers when they arrive. You will do this by working through a project manager who works in your firm's main office.

While a job is in progress, you will constantly be checking to see if materials that are scheduled for delivery are ready. You should never be far from the job site, because if workers run short of materials, you must order more immediately. It will also be up to you to decide how to return unused items.

At this point it may seem to you there are so many details to keep up with that the job is impossible. It can be difficult, but good expediters work out file systems so no details are overlooked. A very good expediter can look after only two or three big projects at the same time, but usually has only one project to supervise.

As an expediter, you must be able to express yourself in a clear, concise and friendly way. You must also be able to listen well. Your communications must be accurate to avoid serious misunderstanding. If you get along well with people and you like to deal with people more than you like to deal with things, then you may like this part of the construction industry.

You will not always work a 40 hour week. During some parts of the job you may not need to be at the job site until late, while at other times you may need to be there very early. During bad weather you may not need to be there at all. The thing to remember is that you are being paid to do a job whether it takes 40 hours or 70 hours per week.

Your salary will be tied to the sort of wages being paid in your area, as well as the amount of activity in the construction industry. The size of the firm you go to work for will have a bearing on your salary. Your school counselor should be able to give you some idea of the wages being paid in your area.

What education and training are necessary to get these jobs? First, the job of expediter is one that you'll grow into professionally. Some expediters begin as craftsmen, such as carpenters, and then find that they like this kind of responsibility more. Some start out in the material distribution part of the industry, find they like expediting and eventually become expediter for independent contractors.

A person who wants to become an expediter should acquire several specific skills. These include being able to look at several things at one time and decide on a practical plan of action. Another important skill is the ability to take a set of specifications,

diagrams or written instructions and set up a schedule to get the job done in a given amount of time.

Expediting, like many other jobs in construction, is becoming more complicated. For the person who is willing to work hard to learn it, expediting can be a fascinating and rewarding career.

SURVEYING

Surveying is the process of fixing boundaries or finding the shape and area of any part of the earth's surface. Surveyors play an important part in building highways, airports, bridges, dams and other structures. They provide information about the boundaries and physical characteristics of building sites. They also collect information to help set land valuations and obtain information for maps and charts. The surveyor precisely measures the distance between points and locates elevations, points, lines and contours on or near the earth's surface.

Surveyors work out of doors and are usually grouped into field parties. A field party is made up of several different kinds of employees. One is called a *rodholder*. Rodholders use a level rod, stadia board or range pole to assist in measuring elevations, distance and directions.

The next person is the *chainholder*. The chainholder uses a metal tape or surveyor's chain to measure distances between points.

Next is the *instrument reader*. This is the person who sets up, adjusts, and operates surveying instruments at the points designated by the surveyor. this person must be able to operate with precision the theodolite, transit, level, altimeter and various electronic measuring devices.

The *party chief* is the most skilled person in the field party. This person is likely to be the only licensed surveyor in the field party, and duties include planning the fieldwork, selecting survey reference points, determining the precise location of natural and other features of the survey region, recording the information disclosed by the survey, making mathemetical calculations based on this information, verifying the accuracy of survey data and preparing maps, sketches and reports. The party chief is directly responsible for the survey and its accuracy with the emphasis on *accuracy*.

1. LAND SURVEYS — those surveys which are used to fix boundaries and to find the areas of plots of ground.

2. HIGHWAY SURVEYS — a specialized kind of land survey which is concerned with establishing the points, grades and lines needed for highway locations.

3. TOPOGRAPHICAL SURVEYS — those surveys which measure elevations and depressions within the region and which show the location of distinguishing surface features.

4. GEODETIC SURVEYS — used to find large areas or boundaries.

5. PHOTOGRAMMETRY OR AERIAL SURVEYS — determine distances on the ground by means of pictures taken from the air.

Surveyors use a number of different tools, but the most important is the transit. The transit is a small telescope set on a tripod which measures very small fractions of degrees; levels point to the exact spot where the surveying instrument is set up.

New developments in surveying include the use of microwave, infrared and laser techniques. With these instruments, surveying can even be done at night.

If you are interested in going into surveying as a career, you should ask yourself the following questions:

1. Am I the kind of person who is precise and accurate and gets pleasure from being so?

2. Do I like to work outside, whether conditions are comfortable or not?

3. Do I have above average mathematical skills?

If you can answer "yes" to all of these questions, surveying may be a good career choice for you.

To prepare for this occupation, your high school studies should include courses in surveying, algebra, geometry, trigonometry, calculus, drafting and mechanical drawing.

If you need to go to work directly after you finish high school, you may be able to find work in surveying. Persons with a limited amount of training and experience usually start out as rodholders and gradually learn more skill through actual job experience.

Photogrammetry is a very specialized field, and those who want to work here need a bachelor's degree in engineering or in the physical sciences. Many surveying party chiefs hold a college degree in civil engineering, although this is not a requirement of the field.

Surveyors will be needed in increasing numbers due to the rapid growth of cities. Growing cities need surveys to locate boundary lines and to lay out streets, shopping centers, schools and recreational areas. Surveyors will also be needed to meet the demand for construction and improvement of our highway systems. Surveyors are employed in all sections of the country and in small towns, as well as in urban areas.

Surveying is not considered a hazardous occupation. There are occasional accidents, as in all kinds of outdoor work — sunburn, heat stroke, frostbite and poison ivy.

As with all the other occupations, salaries for surveyors vary widely from one part of the country to another.

You may find out more by contacting:

- American Congress on Surveying and Mapping
  Woodward Building
  733 15th Street, N.W.
  Washington, D.C. 20005
- American Society of Photogrammetry
  150 North Virginia Avenue
  Falls Church, Virginia 22046

TESTING AND INSPECTING

The process of testing and inspecting goes on at every phase of construction. It starts before a building is begun and goes on until after the building is occupied. When most people speak of an inspector, they are referring to a construction inspector, because that job is the most widely known, but inspection is also done at many other points in the industry.

One place where testers and inspectors work is in manufacturing building materials. All building materials are standardized; this means that all building materials must meet certain given standards. Because of standardization of materials, you can call for a certain grade in your specs and be assured of consistent quality. Testers and inspectors check materials as they are manufactured to make sure they meet these standards.

Not only has testing begun long before a project has been started — in fact, testing and inspecting usually continues until the owner has occupied the building. At almost every step in the building, inspectors and testers check the materials and workmanship, knowing that it is far easier to correct a mistake when it's made than to correct it later.

After the surveyor checks the lot boundaries and locates the building edges, a foundation crew comes in to put down the forms for the concrete slab foundation. The crew puts down forms according to the blueprints which provide for beams of the right size. Inspectors check before the concrete foundation is actually poured to ensure correct elevation, and to ensure that they are the right size and properly spaced. As concrete trucks arrive, the concrete may be tested to determine if it meets specifications. One test used is called a slump test and is used to check that the proper amount of water has been used in the mix.

After the slab is poured, finished and cured, the forms are removed and another inspection may be called for. This time the inspector looks for bulges, rough spots or other defects in the concrete. If defects should exist, they are chipped out and patched and if they then pass inspection, the construction goes on.

The electrical wiring, ductwork, plumbing and other mechanical apparatus are installed, and inspected to ensure they follow local building codes and government regulations.

The outside wall, insulation and inside walls are now put up. If brick, block or stone is used, an inspector verifies that the footings are level, the brick, block or stone is free from flaws and meets color specifications. Checks are made on the workmanship of such things as size and uniformity of the joints between the bricks, blocks or stones. The inside walls may also be inspected for workmanship; then the trim, cabinetwork, painting, tile and floors may each be inspected to meet specifications.

An inspector usually keeps a log of the construction and the inspections, and will compute the percentage of work completed and approve payment to contractors.

From this description you've learned that inspectors have a lot of responsibility. It is not always easy to check whether a building meets standards. An inspector must know building procedures and materials thoroughly. Also an inspector must be able to apply mathematics to specific situations. And finally, the inspector must be able to visualize three-dimensional forms and relationships from blueprints and drawings and distinguish the details in them.

Inspectors do a great deal of walking and some crawling and climbing, and are subjected to dust and noise. They use hardhats, protective eye shields and, if there is a high noise level, wear ear plugs to avoid possible injury to hearing.

Inspectors do not work a traditional 40 hour week, but they are hired to do a job, sometimes taking more than 40 hours.

An inspector will receive a salary equal to or greater than the top worker on the job. In order to get some idea of the salary an inspector in your locality makes, ask your instructor or counselor.

If what you've read so far about inspecting sounds interesting, you'll want to know how to become an inspector. Many people become inspectors after getting the knowledge they need in other areas. They often move into inspecting from skill areas such as carpentry, masonry, etc. Inspectors on larger jobs, and more specifically overall inspectors, often have an engineering background such as civil or mechanical engineering.

Here are some things you should be able to do well if you are to be a successful inspector:

1. Apply scientific problem-solving methods and logic to reason out problems and reach sound conclusions.

2. Read and interpret technical descriptions from manuals, mathematical tables, or working drawings.

3. Write clear, concise reports and keep accurate and complete records of the progress made on a job.

4. Express yourself in an open straightforward manner which indicates you have both the knowledge and self-confidence to do the job.

If you have the desire to rise to the top in a company and you like the kind of responsibility you would have as an inspector, then this can truly be a challenging career.

For more information write to:

- American Society for Quality Control
  161 West Wisconsin Avenue
  Milwaukee, Wisconsin 53203

- American Society for Testing and Materials
  1916 Race Street
  Philadelphia, Pennsylvania 19103
- National Association of Women in Construction
  c/o Jack T. Holmes and Associates, Inc.
  2800 W. Lancaster
  Ft. Worth, Texas 76101
- Society of Women Engineers
  345 East 47th Street
  New York, New York 10017

CONSTRUCTION MATERIALS DISTRIBUTION

Material distribution is a broad family of jobs and includes many different tasks. Supplying materials to an industry as large as the construction industry is a huge task. It is a growing, dynamic, thriving industry that uses the latest technology and merchandising methods to get the best materials to builders at the lowest prices. It also keeps builders informed about what is available and at what price.

There are four basic kinds of work found in every business:

1. Receiving,
2. Storing,
3. Selling and
4. Buying.

If you are new in the business, you will probably start out helping with the receiving and storing processes.

When merchandise is *received* a record is made of it. You might help the receiver make reports on the merchandise. These reports will be checked back against the invoices on the shipment. You will record any shortages, breakages or overages, mark the merchandise for price and put it either in stock or storage.

Another task you might help with as a newcomer in the business is *storing*. In storing you will help to keep the merchandise arranged in a neat and attractive fashion.

Selling is clearly the most important function in a store. A well trained salesperson can usually talk with knowledge and authority about all of the firm's products. If you like meeting and talking to people and can be courteous and businesslike, you may like selling. Also, as a salesperson you should study and become adept at advertising and setting up store displays.

After you really know the business and understand buyer preferences and trends, you may become a materials *buyer*. Buying is a very exacting skill and requires good business sense. As a buyer you must know what people want, will purchase and at what price.

These are very general descriptions of the four basic tasks in material distribution. Your goal should be to decide exactly what kind of job you want and then go out and find it.

Certain parts of material destribution, such as receiving and storing, often require considerable physical work. Sometimes you may be required to lift and move heavy objects, so you should have the physical stamina to be active for a good day's work.

Another area of material distribution you may want to know more about is working conditions. Most of your work in material distribution will be relatively clean. In receiving and storing it may be dusty or you may have to work in extreme temperatures. Most of your work will be indoors, usually in pleasant surroundings.

In material distribution you normally work a 40 hour week. This 40 hour week will not always be Monday through Friday, however. Many supply stores stay open on Saturday or at least on Saturday morning. In some supply businesses you may occasionally have to unload a shipment of materials at night or on Sunday.

What can a person employed in material distribution expect to make. The first factor is your importance to the company. When you start out in receiving or storing, you'll probably be paid a min-

imum wage. You are doing at that point what could be done by anyone who has the physical capability. Then as you learn the job and accept responsibility for getting things done without being told or supervised, you will be given raises. If you seek and accept more responsibility you'll probably be paid more. If you move into selling and do a good job, additional raises will be given. And if you learn enough to become a buyer, you'll be worth even more to the company.

In deciding about work, you should think about how much training you would need to do the job. In material distribution you can go to work in most wholesale and retail building and material supply houses with little or no formal education beyond high school. You can get a good background for entry into material distribution by taking such courses as drafting, general business and distributive education or industrial cooperative training in high school.

What you accomplish once you are on the job is all up to you. If you work hard on the job, educate yourself about the products and the services, and be loyal to your company then you will certainly advance in this field. When specialized training is needed, your company will often pay for this.

In addition to the background which you'll get in high school courses, what else is there that will ensure your success on the job? It's a combination of things—mental alertness, ability to communicate with others, a willingness to accept responsibility and to educate yourself. This self-education is an important factor in your future success.

If your career goal is in this field, you should be able to look forward to a good future.

CONSTRUCTION MANAGEMENT

Construction managers (CM) oversee every phase of the operation. They meet with owners and watch the designing of the building to make sure that the design will meet their needs. They also make sure that the designs can be readily built using available equipment and methods of construction. If something is wrong with the design, the CM team makes sure that the architects correct it.

CM teams oversee the selection of contractors and develop the scheduling for the project. Once the construction is started, they coordinate the entire operation and schedule activities, making sure that the work meets the architect's specifications; keeping a close watch to keep cost control and scheduling efficiency factors as low as possible.

This job is highly technical and complicated. The construction manager has to know a great deal about construction techniques, accounting, estimating and expediting to accomplish the job of planning, scheduling, administering and controlling the cost of a large project. It's a lot of work and no one individual can do it all; that's why construction managers work as teams. Nevertheless, most workers in the field know something about the work of all the members of the group. Most will be familiar with at least some aspects of construction, accounting, business administration, planning and computer operations.

Write to these organizations for further information:

- The Consulting Engineers Council
  Madison Building
  1155 15th Street, N.W.
  Washington, D.C. 20005
- American Institute of Architects
  1735 New York Avenue, N.W.
  Washington, D.C. 20006
- Associated General Contractors of America
  1957 E Street, N.W.
  Washington, D.C. 20006

INTRODUCTION TO CAREERS IN HEAVY EQUIPMENT

There are three types of construction workers who use heavy equipment:

1. Heavy equipment operators,
2. Heavy equipment mechanics and
3. Heavy equipment parts people.

Each of them is important in making sure that whatever is being constructed gets built on time and within the cost limitations that the contractor has established.

Heavy equipment operators and mechanics operate and maintain various types of power-driven construction machinery, such as power shovels, trench excavators, bulldozers, tractors and pumps. Some of these machines are relatively simple; some are complex.

The range of skills required for both the operation and maintenance of these machines varies widely from one machine to another. Anyone who desires steady employment in this field should be able to operate several different types of equipment.

HEAVY EQUIPMENT OPERATORS

Heavy equipment operators work with large pieces of machinery that are designed to move or lift heavy materials. Most of the time they work outside, but modern machines do provide some shelter from the weather. The work is often seasonal, with rain, cold weather and snow usually influencing the number of days on which operators can work.

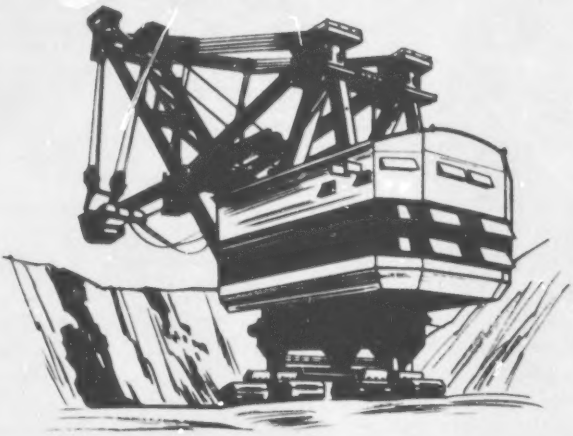
Heavy equipment is usually classified into three groups:

1. Earthmoving or grading and paving equipment;
2. Boom or universal equipment, including revolving cranes or shovels used for handling asphalt, concrete, water, etc.;
3. Support equipment.

Earthmovers are used mainly in highway building, dam construction and construction where ground is excavated or material is stockpiled. Boom equipment is used in hoisting, pulling and lifting materials. Cranes, draglines, shovels and hoes are considered boom equipment. Support equipment includes water trucks, rollers, paving equipment, plant equipment compressors and fuel, water and grease trucks.

In looking for a job, a heavy equipment operator has one great advantage. Construction work goes on almost everywhere, and there are as many different kinds of construction projects as there

are kinds of heavy equipment to work on them. Whenever anything heavy must be moved or lifted, some kind of equipment is needed. Projects that require heavy equipment include building dams, construction of large buildings, construction of local, state and interstate highways, land clearing, stock tank building, land terracing, oilfield mining operations, canal and river construction, gravel and sand pits, logging, electrical and telephone line construction, shipping and water cargo handling, bridge building and demolition of old buildings.



All construction begins with the use of some type of heavy equipment. It is usually in use until the project is finished. For example, earth moving equipment prepares a construction site for excavating and boom equipment is used during the building phase. When buildings are no longer needed, heavy equipment does the demolition and cleanup work.

Most heavy equipment operators work outside and work steadily during warm dry weather. They have slow periods during cold or wet weather. Although pay scales vary from place to place and from machine to machine, the pay is generally high. In areas where the level of construction is reasonable high, an operator may not work twelve months out of the year, but his income is generally good when averaged over the year.

Education and Training

Education and training requirements for heavy equipment occupations continue to rise. Machines have become highly complex, but are easier to operate. If you are interested in becoming an operating engineer, there are courses you should take while in school:

Mathematics, geometry and algebra, blueprint reading, drafting, English, physical science (including geology), machine shop and auto mechanics.

After leaving high school, you will have a number of questions to think about. Should I seek more training in heavy equipment operation? Should I go directly to work? Should I serve in a military branch? Should I join a union of operating engineers?

In the average heavy equipment training program, the apprentice learns to handle equipment and tools safely, set grade stakes, read plans, follow instructions and develop good work habits and attitudes. The apprentice learns to use welding and cutting equip-

ment and to use oils and grease properly. Some industrial companies train beginning employees to meet their specific job requirements. Apprenticeship programs, when available, are generally considered to be excellent sources of training.

Safety Factors

Most work in heavy equipment operation is considered hazardous, but contractors are very safety-conscious, especially since the passage of the Occupational Safety and Health Act. Accidents and injuries are often caused by operators' carelessness, but may be caused by working conditions established by the employer. Although working on steep slopes and driving on slick roads is hazardous, snapping cables and broken bones are usually caused by faulty maintenance or by the operator's neglect.

Each particular job in heavy equipment operation has its advantages and drawbacks. It would be hard to make a special list for each operation, but there are some general ideas to consider:

- The heavy equipment operator has a part in molding a permanent piece of work, whether it is a housing project, dam, highway or public building.
- In heavy equipment, each person works as a team member—each sharing a vital role in the successful completion of the project.
- Many persons gain a great deal of satisfaction from the feeling of controlling power for a useful and constructive purpose.
- Operating some machines is physically tiring because of the constant shaking and jolting movement of the equipment.
- Bad weather and the type of construction may force long periods of inactivity.
- Exposure to extreme weather conditions may also cause physical discomforts.

Advantages and disadvantages are difficult to list, because what may seem a disadvantage to one person may be an advantage to another. Some people like the idea of being able to move around, never staying in one place too long. You should consider all aspects of any job before you commit yourself to a career field.

HEAVY EQUIPMENT PARTS PEOPLE

Heavy equipment parts people generally work in warehouses where spare parts for heavy equipment are kept. They have to be sure that the parts the mechanics need are there. They work steadily and bad weather usually means more work for them.

Besides knowing the parts different kinds of machines use, heavy equipment parts people must also keep records of the parts on hand and the parts sold so that orders can be made when supplies are running low. Paperwork may be a big part of this job.

Heavy equipment parts people can work in several areas. Most are found in the parts section of a repair shop located in a heavy equipment sales and service company.

Heavy equipment parts people are divided into categories according to skill and experience. Most start in the warehouse. Their duties include receiving and shipping various parts. They also fill orders for customers. This same person may deliver parts to other service companies or to construction sites. Other people work at the counter, taking and filling orders.

Some large construction companies, with their own maintenance departments, have a person who orders, maintains and dispenses heavy equipment parts. Other operations which might hire heavy

equipment parts people are bus and trucking companies, automobile dealerships, independent auto parts dealers and any other companies which find it feasible to have their own parts department.

The nature of the work done depends on the particular job assigned in the parts house. If you were to work in the warehouse section, you would be mainly responsible for receiving parts, shipping parts and filling orders. Each part of this job has different responsibilities.

Usually orders are taken by experienced heavy equipment parts people and passed back to the newer or younger employees for filling. It is necessary that employees keep a serious attitude when filling parts orders. Poor parts and maintenance services can result in poor equipment sales for the dealer in the future.

The places where trained and experienced heavy equipment parts persons can find employment are numerous. They can work for heavy equipment sales service companies, construction companies, trucking companies, bus companies, franchised auto parts houses, new car sales and service companies, machine and supply companies, oil field equipment companies and so forth.

Most heavy equipment parts people are hourly workers, but in a few cases they receive a monthly salary. This will vary from one geographical location to another and is related to the cost of living in the area. Most persons work between 40-48 hours per week. If they work overtime, they usually receive at least time-and-a-half pay.

Job security is closely related to the construction activity in a particular area. Increased construction means increased purchases of heavy equipment machinery. This in turn increases the amount of maintenance and the number of parts required.

Heavy equipment parts is a career which is spread over several areas including retailing, auto mechanics, heavy equipment mechanics, wholesaling, delivery and bookkeeping. The parts person should be interested in heavy equipment machines and their functions, enjoy working indoors, have a good memory, be capable of dealing with numbers and be able to work with people.

The work sometimes requires working in cold, drafty warehouses. The work is sometimes dirty and exacting. Those working on counters usually work in comfortable, well-lighted, clean surroundings. Working hours may be irregular, since repair of heavy equipment is an around-the-clock service. People are paid less per hour than mechanics and operators, but their work is steadier. Cheerfulness and efficiency are necessary personality traits under these circumstances.

The main hazard in heavy equipment parts work comes from careless lifting or moving heavy parts. Another physical problem may be caused by spending most of the day standing or walking. Good feet and a strong back are essential.

HEAVY EQUIPMENT REPAIR

Heavy equipment mechanics do much the same job as other mechanics in industry. They repair broken machinery and do routine maintenance needed to keep the equipment running well. Many heavy equipment mechanics work in the field. When large equipment that is difficult to move breaks down, they are called in to make the repair.

Other heavy equipment mechanics work mainly in shops. They repair heavy equipment that is movable, do complicated work that requires shop facilities and do routine maintenance on equipment

that is brought in during slack periods. They may work for companies specializing in this, or they may work for heavy equipment sales organizations or contractors which operate their own repair shops.

Because heavy equipment is complex, most who are school-trained start as mechanics' helpers. It usually takes about five years experience to become a skilled heavy equipment mechanic.

Training in heavy equipment maintenance work includes diesel engine,farm equipment, heavy truck, bus, auto and industrial machine repair. The diesel engine mechanic can repair and maintain diesel engines, railroad equipment, construction equipment and farm equipment. They also maintain and repair a variety of other diesel-powered equipment, such as generators, compressors and pumps used in public utilities and on well drilling or work-over rigs.

Wages and Opportunities

Wages for heavy equipment mechanics vary with the complexity of the job, as well as the geographical location. Many heavy equipment mechanics receive overtime pay since it is important that a broken machine be repaired as quickly as possible. When working overtime, heavy equipment mechanics generally receive more pay per hour.

Jobs for heavy equipment mechanics are expected to increase because of building activity. More mechanics will be needed to repair diesel engines, as these engines will be used in place of gasoline engines. Much farm equipment is now diesel powered, and small delivery trucks are expected to use more and more diesel engines. More truck and bus mechanics will be needed because of increased freight transportation and bus travel between cities.

Most heavy equipment mechanics have steady jobs if they work for an established heavy equipment sales and service company. Employment for mechanics hired by construction companies may vary with the company's contract to complete a job. Heavy equipment mechanics in construction have an advantage over heavy equipment operators, since mechanics usually work during weather which would force a machine operator to be idle.

The main safety hazard in heavy equipment maintenance is the weight of the machinery being repaired. Every company has strict safety rules applying to moving, blocking or lifting pieces of heavy equipment.

Education and Training

School courses that will add to your practical experience include reading, math, physics, general science, blueprint reading, drafting, welding and others suggested by your instructor or counselor.

Many private and public trade schools have courses in heavy equipment mechanics or diesel engine repair. These courses usually offer complete training in heavy equipment maintenance

and repair, with practical experience and related classroom instruction.

For more infomation about heavy equipment operation, repair or parts work, ask your instructor, vocational counselor or write to:

- Associated General Contractors of America, Inc.
  1957 E Street, N.W.
  Washington, D.C. 20006
- International Union of Operating Engineers
  1125 17th Street, N.W.
  Washington, D.C. 20036

INTRODUCTION TO CAREERS IN METAL WORKING

You may be familiar with welding because it's probably the best known of the metal working occupations. You may know something about sheet metal work because a friend works with sheet metal.

WELDING

One of the first questions you might want to ask about welders is, "What does a welder do?" If you were a welder, you would join metal parts together in one or more of literally thousands of jobs where welders are employed. You might make new parts or repair broken ones. You might do construction welding on the 20th floor of a skyscraper, or maintenance welding in the hold of a ship.

Welders join pieces of metal together. Sometimes a welder also adds filler metal to a weld. The result is a permanent bond. The weld where two pieces of metal are joined is often stronger than the metals themselves. There are about 40 different welding processes used, but most welding is done by one of three ways: Gas, arc or resistance.

A skilled welder knows what must be considered when welding steel, stainless steel, cast iron, bronze, aluminum, magnesium, nickel or other metals and alloys. The welder works from drawings, blueprints or written specifications and lays out the work. The welding tasks are arranged in logical order and the welder decides what should be done—a flat, vertical, horizontal or overhead position weld, what welding rod will be used and what current setting is best.

The semi-skilled welder does fairly routine tasks, like making welds in the flat position. Work is usually laid out from plans or specs and usually is done by a supervisor.

Gas Welding

Gas welding, also called oxyacetylene welding, is used mainly for welding thin pieces of metal together and for making specialized welds such as brazes. The welder uses a torch, which burns a mixture of oxygen and acetylene gas, to apply an intense, hot flame. The edges of the two pieces to be joined are heated and when they are hot, the welding rod is touched to them. The rod melts and sticks to the metal. When the edges cool, the pieces of metal are joined by a permanent bond or weld.

The gas welder has to think about many things before starting work. The welder must consider types and thicknesses of the metal to be welded, the type of joint to be made, the type and size of rod to use for filler and the size and quality of flame that will give exactly the right heat for the job.

Arc Welding

Arc welding is probably the most widely used of all the welding processes. The welder strikes an arc by touching an electrode to the metal to be welded, completing an electric circuit. The welder then pulls the electrode back a short distance from the metal, and an electric spark, or arc, forms between the electrode and the metal. This arc is extremely hot—so hot that the electrode tip and the edges of the two pieces of metal melt in the "flame." The molten metal cools and hardens as the welder guides the arcing electrode down the plate to complete a seam or weld.

After the welder has used up the foot-long welding rod, it is replaced, another arc struck and the weld continued. An accomplished welder knows what size electrode to use for a particular thickness of metal, what type of electrode to use for that specific metal and the position to weld it in. After considering these things, the welder sets the welding machine to the proper electric current.

Another kind of arc welding job is underwater welding. The underwater welder combines the talents, training, knowledge and skills of the diver with those of the arc welder and arc cutter and thus joins a highly specialized, small group of well-paid workers.

There is one other specialist that should be mentioned, the combination welder. This welder is an individual skilled both in arc and gas welding.

Resistance Welding

Resistance welders are highly specialized machine operators. They set-up, feed-in and align work, adjust the controls of the machine for electric current and pressure and remove the work after the welding is finished. Resistance welding rigs are very expensive, and for this reason there are few jobs now available in this field.

Oxyacetylene and Arc Cutters

Oxyacetylene cutters and arc cutters are sometimes called flame or thermal cutters. These workers hand guide their cutting torch to cut or trim metal. They sometimes cut away excess metal from castings and cut scrap metal into pieces of manageable size. An example of this is the person who uses an oxyacetylene cutting torch to cut up old cars at an auto wrecking yard so that they can be processes as salvage.

The oxyacetylene cutter "cuts" the metal by directing an acetylene and oxygen flame to the area that is to be cut until the metal begins to melt. A lever is pressed that shoots a stream of

oxygen to the spot and it literally blows the molten metal away, thus "cutting" it.

Arc cutting differs from oxyacetylene cutting in that it uses an electric arc as the source of heat. The principle of melting the metal and then blowing it away remains the same. Arc cutting is used extensively by underwater welders, and other special forms of arc, such as the plasma arc, are used to cut special metals.

Welding does not require any unusual strength. A welder may be standing, stooping and bending for long periods of time. Good manual skill, eyesight and eye-hand coordination are important.

Welders must be safety conscious all the time. Protective clothing, gloves, goggles and a helmet must be worn to prevent burns and eye injuries. Precautions must be taken to ensure proper ventilation when welding, because poisonous gases can be created by welding certain metals.

Jobs in the Future

Welding is being used on more and more different jobs, and the long range outlook for the metal working industries is excellent. Many welders will be needed for maintenance and repair work in the growing metal working industries. Plants which produce

ships, storage tanks, oil field and industrial metal products, as well as those producing sheet metal products, are expected to need more manual welders throughout the next ten years.

To obtain additional information write to:

- The American Welding Society
  2501 N.W. 7th Street
  Miami, Florida 33125
- International Union, United Automobile, Aerospace, and Agricultural Implement Workers of America
  8000 East Jefferson Avenue
  Detroit, Michigan 48214

SHEET METAL WORK

Many people know something about sheet metal work, but few realize how broad and complex this area really is. If you were to go into sheet metal work, you might have a job making air conditioning ducts that will go into a large office building or a house; or you might have a job making stainless steel countertops for restaurant kitchens; or you may work for a company building mobile homes; or an aircraft corporation making the wings or bodies of giant jet airliners. The jobs in sheet metal range from simple to complex and from small to very large.

As a construction sheet metal worker you might make and install ducts used in ventilating, air conditioning and heating systems. You might also make and install one or more of many other products made from sheets of metal such as roofing, siding, storefronts, partitions and all kinds of frame work.

In duct work, the skilled construction sheet metal worker takes the blueprints and plans and lays out the job. The size and type of sheet metal to be used is determined. These may be made at the shop and then hauled to the construction site where they can be assembled with as little change as possible.

Sheet metal workers making the ducts, cut the sheet metal with power shears, hand snips or other cutting tools. Then they bend, crease and shape the metal with a variety of machines, hammers and anvils. Next they weld, bolt, rivet, solder or cement the seams and joints. Finally, the ducts are ready to be sent to the job where they will be fitted together, then soldered, connected or welded and attached to hangers or braces for support.

Education and Training

You can expect several things from a typical training program in sheet metal work. First, you will learn how to use and care for all the tools used. You will constantly be aware of *safety*. You will learn about the materials commonly used and you will learn the processes such as cutting, forming, folding, grooving, bending, punching and drilling, welding, soldering and seaming.

Many people think that apprenticeships are the best way to learn about sheet metal work. Apprenticeships in sheet metal working last four years. Apprentices should be between 17 and 23 years of age, have a high school education or its equivalent and have good physical and mechanical aptitude.

Another way to become a sheet metal worker is to learn the trade by working as a helper. Many people have been taught by experienced personnel and have learned more about it by taking correspondence or trade school courses. Some have advanced to foremen or superintendents or have gone into business for themselves.

Working conditions for a construction sheet metal worker vary. First, a lot of time is spent at the construction site where the contractor has the job. You might work in awkward, cramped places and have to crawl or stoop for long periods of time. If you were putting on roofs and installing gutters and skylights, you would be out of doors and perhaps work several stories above the ground.

The average pay, gauged by union minimum hourly wage rates, is better for sheet metal workers than for the rest of the construction trades workers.

Outlook for Sheet Metal Work

The future of sheet metal work looks good. Experts expect expansion of residential, commercial and industrial construction. Central heating and air conditioning systems are being installed in most new homes, schools, hospitals, stores, office buildings and factories. This will create many new jobs through the seventies. Several thousand sheet metal workers will be needed, in addition, to replace journeymen who get other jobs or retire.

For further information, ask your instructor and counselor or write to:

- Sheet Metal Workers International Association
  1000 Connecticut Avenue, N.W.
  Washington, D.C. 20036
- Sheet Metal and Air Conditioning Contractors'
  National Association, Inc.
  1611 North Kent Street
  Arlington, Virginia 22209

PLUMBING AND PIPEFITTING

Plumbers and pipefitters do very similar types of work. Both install and repair pipe systems needed by homes, businesses and industry which carry water, steam, air or other liquids or gases needed for sanitation and industrial production. They also install plumbing fixtures, appliances and heating and refrigeration units.

Although plumbing and pipefitting are often considered to be a single trade, there are differences between the two. Plumbers are primarily responsible for installing services such as gas lines, drains, sewers and water supply systems. They also install radiators, water heaters and plumbing fixtures. Their services are required in the construction of homes and commercial and industrial buildings.

Pipefitters, on the other hand, are most likely to work only on industrial and commercial buildings; or they might be involved in the construction of a defense establishment, such as a missile launching site. Pipefitters install high and low pressure pipe systems to carry hot or cold water, hot or cold air, steam and other liquids and gases needed by commercial and industrial establishments.

Plumbers and pipefitters use a wide variety of skills. They must know how to use many different types of tools and equipment. Skills used include welding, brazing, caulking, soldering and threading joints. Their tools include wrenches, reamers, drills, braces and bits, hammers, chisels and saws. For bending, cutting and threading pipe, power tools and machines are used. They also use gas and oxyacetylene torches and welding, soldering and brazing equipment.

Annual earnings of workers in this field are among the highest in the building trades, primarily because their work is not affected by seasonal factors.

There are many places of employment for plumbers and pipefitters. Most are employed by plumbing and pipefitting contractors in new construction activity. Others are self-employed. There are also employment opportunities with government agencies and public utilities. There are job opportunities for pipefitters in the petroleum, chemical and food-processing industries where fluids are processed through pipes in their industrial operations.

The work of plumbers and pipefitters is active and sometimes strenuous. They frequently stand for long periods of time and sometimes work in cramped and uncomfortable places. Plumbers and pipefitters are not affected by as many on-the-job injuries as other kinds of construction workers.

Education and Training

There are several ways to learn the trades of plumbing and pipefitting, but most training authorities recommend a five year apprenticeship program. Apprentice applicants are generally required to be between 16 and 25 and in good physical condition. It is recommended they have a high school education which includes courses in mathematics, physics and chemistry. And it is extremely important that they have a high degree of mechanical aptitude.

The apprenticeship program is designed to teach the plumber or pipefitter how to use, care for and safely handle the tools, machines, equipment and materials used in the trades. The plumber apprenticeship program includes training in the installation of sewers, drains and drainage systems, water supply systems, vent systems, water heaters and appliances. The plumber

apprentice also learns how to test, repair and maintain the systems and equipment to be installed. The pipefitter apprentice learns how to install heating and air conditioning systems, powerplant piping systems and pneumatic control systems. Instruction includes how to install and maintain radiators, pumps, boilers, stokers, oil burners and gas furnaces.

Many plumbers and pipefitters have acquired their skills informally by working with experienced personnel for several years. In this type of training, the trainee observes and receives instructions from trained personnel while acquiring the necessary skills. Additional knowledge of the trade can be gained by taking trade or correspondence school courses.

If you are interested in apprenticeships or work opportunities in these trades, you can obtain information by writing:

- United Association of Journeymen and Apprentices
  of the Plumbing and Pipefitting Industry of the
  United States and Canada
  901 Massachusetts Avenue, N.W.
  Washington, D.C. 20001

More general information on plumbing and pipefitting may be obtained by writing to the following:

- National Association of Plumbing-Heating-
  Cooling Contractors
  1016 20th Street, N.W.
  Washington, D.C. 20036
- National Automatic Sprinkler and
  Fire Control Association
  277 Park Avenue
  New York, New York 10007

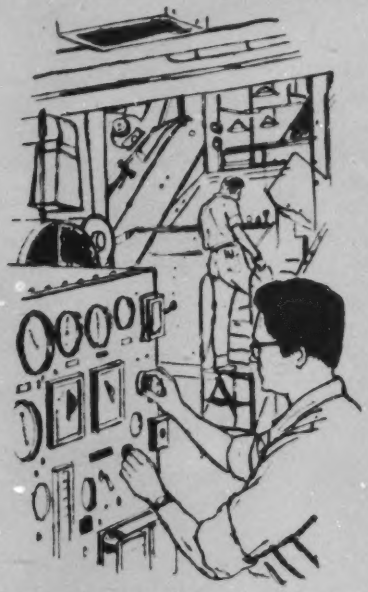
AIR CONDITIONING AND REFRIGERATION MECHANICS

From the discovery at the turn of the century that ammonia, when put into a partial vacuum, boiled and made its container cold, grew a tiny industry—an industry that offered consumers a way to keep food cool and make it last longer.

By the sixties, most of the problems related to cooling large areas economically had been solved, and air conditioning became commonplace. Today, it would be considered almost unthinkable to construct any large building (or small one for that matter) without air conditioning. Installing and maintaining these millions of air conditioning and refrigeration units is the job of the air conditioning and refrigeration mechanics.

Air conditioning and refrigeration mechanics work in all types of construction and on all types of units. These systems can range in size from a giant central air conditioning system in a large department store, to a small window air conditioning unit in a house. When installing one of the larger units, the mechanic builds the system out of component parts by installing the motors, compres-

sors, evaporators and all components according to specifications and blueprints. Duct work is connected and the refrigerant line, other piping and the controls (thermostats and switches) are properly installed. The system is connected to the electrical power source. After completing the installation, the system is charged with refrigerant and checked out to make sure that it operates properly.



Those who install and maintain air conditioning and refrigeration systems use similar tools and equipment. These include drills, pipe cutters, threaders, benders, torches and hand tools, as well as test equipment such as pressure gauges and ammeters.

FURNACE INSTALLERS

Furnace installers, oil burner mechanics and gas burner mechanics have a great deal in common with air conditioning and refrigeration mechanics. All three work from specs and blueprints, use the same type of tools and do many of the same tasks. The difference is that these mechanics install oil, gas and electric heating systems rather than air conditioning units. A furnace installer sets the units in place, connects or sees that the duct work is properly connected and installs fuel lines and other parts. The controls (thermostats and switches) are installed and tie the system into the electrical supply. Finally, the unit is turned on and the entire system is checked out for proper operation.

OIL BURNER MECHANICS

Oil fuel heating systems are used a great deal in the northern United States and are especially popular in areas around big cities.

The oil burner mechanic services and adjusts oil-fired heating systems. If a system is not working properly, the mechanic checks it out by starting with the thermostat, burner nozzles, controls or other parts. The mechanic usually drives a service truck and carries a stock of replacement parts in order to make on-the-spot repairs in the customer's home or business. If major repairs are required, the unit may have to be disassembled and some of the parts taken to the repair shop.

Although this type of work is pretty seasonal, at least part of the summer is spent servicing units for the next winter. Many oil burner systems are used to heat hot water throughout the year. Some of the things done in the summer include replacing oil filters and air filters and vacuuming ducts for accumulated soot or ash.

GAS BURNER MECHANICS

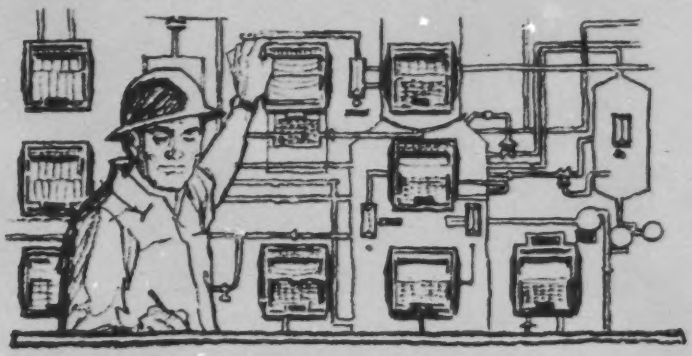
It was noted that oil fuel is used for heating in some of the northern States. In other States, such as Texas and California, gas is the predominant fuel. These States, therefore, have a need for gas burner mechanics.

Gas burner mechanics have duties similar to those of oil burner mechanics. They diagnose problems and make necessary adjustments or repairs. Gas burner mechanics are often skilled at fixing other appliances that use gas as fuel. For instance, they may repair hot water heaters, gas clothes dryers and even gas cook stoves. Gas burner mechanics face the same decrease in demand for their services in the summer as do oil burner mechanics. Those working for utility companies often spend their summers and "slack" time inspecting and repairing gas meters.

Furnace installers, oil burner mechanics and gas burner mechanics all use hammers, wrenches, metal snips, electric drills, pipe cutters and benders, acetylene torches and a variety of other hand and power tools. They all use similar testing devices such as vacuum gauges, ammeters, voltmeters, air velocity meters and electronic circuit testers.

Mechanics in each of these categories are employed in all parts of the country, with more employed where the population is most dense. Connecticut, Illinois, Massachusetts, Michigan, New

Jersey, New York, Ohio and Pennsylvania are some of these States. Most air conditioning mechanics, of course, are found in the warmer parts of the country.



Air conditioning, refrigeration and heating mechanics work for dealers and contractors who sell and service cooling and heating equipment. Construction companies also hire air conditioning mechanics. Fuel oil dealers and suppliers hire oil burner mechanics and many gas burner mechanics work for gas utility companies. It is possible for mechanics in any of these areas to go into business for themselves.

Education and Training

Most employers want employees to be high school graduates. They want them to have had courses in math, blueprint reading, physics and some mechanical drawing. An interest in electricity is desirable, and good mechanical aptitude, manual dexterity and physical condition is also important.

Apprenticeship programs can train you in these fields. Many employers maintain that a formal apprenticeship program is the best way to become a skilled mechanic. Apprenticeship programs generally consist of 3 or 4 years of paid, on-the-job training, plus some classroom instruction each year. Apprentices usually need a high school education, need to be at least 18 years old and must be in good health.

Generally speaking, the more experience you have, the more money you are likely to make in this field. Skilled mechanics make 2 to 3 times as much as helpers. Also, the more skills you have, the more valuable you are to your company. If you can work on both heating systems and air conditioners, you can command more money. You should check with your instructor to find out about the current salary schedules in the area where you live.

If you are interested in finding out more about training opportunities, contact the following:

- Refrigeration Service Engineers Society
  2720 Des Plaines Avenue
  Des Plaines, Illinois 60018

For information on oil heating systems, write to the following:

- Education Department,
  National Oil Fuel Institute
  60 East 42nd Street
  New York, New York 10017

If you wish to learn more about gas burner mechanics, write to:

- American Gas Association, Inc.
  605 Third Avenue
  New York, New York 10016

MILLWRIGHTING AND INDUSTRIAL MECHANICS

Millwrighting is a term applied to almost any of several skilled workers who deal with installing or maintaining heavy, industrial equipment such as lathes, milling equipment, rolling or pressing equipment and automatic assembly equipment and its lines. The duties of these people vary considerably, as do their titles.

Millwrights do essentially three things:

1. Prepare or construct support structures for industrial equipment and place the equipment on the supports;

2. Position, align and check industrial equipment prior to operating it, and connect any pieces of equipment which must work together;

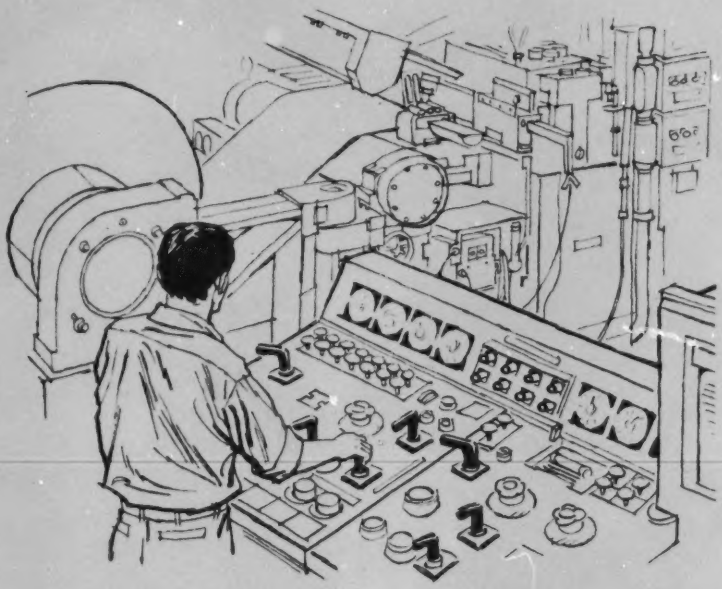
3. Maintain industrial equipment after its installation.

Millwrights who prepare or construct support structures are often called *construction millwrights.* These workers build concrete forms and oversee concrete placement for machine pads. They prepare concrete surfaces, and often. may build temporary frameworks or weld overhead rails and frames into position so that machinery may be hung from these structures while being maneuvered into position.

Millwrights must know a great deal about machinery. They determine if floors are strong enough to hold equipment to be installed. They need to know conditions various types of pumps require in order to work correctly. They must know how to align and balance shafts to critical tolerances. They must be experts at

measuring, and be able to measure and position, with accuracy, irregularly-shaped objects, machine parts' dimensions, etc.

There are also millwrights who maintain equipment after it has been installed. These millwrights are frequently called *industrial mechanics*. Industrial mechanics not only repair machinery, but make preventive repairs before breakdown. This is called preventive maintenance. Most industrial mechanics keep detailed records of what maintenance work they have done so that all work can be done on a regular schedule.



Although there are jobs for millwrights all over the United States, half of the millwrights in the entire country work in six heavily industrialized States: Michigan, Ohio, Pennsylvania, Illinois, New York and Indiana.

Industrial mechanics, on the other hand, work with different machines in different industries. Industrial mechanics work in all parts of the country. As you would expect, most of them work in the heavily industrialized States. The machinery, primary metals, fabricated metals, transportation equipment, chemical and food industries hire the most, although considerable numbers work for the paper, rubber and petro-chemical industries.

Education and Training

Formal apprenticeship programs in millwrighting are available in some areas. These usually take four years and include both classroom instruction and on-the-job training. Most people who become *millwrights,* however, start as helpers to skilled workers and learn their trade through experience. If you are fairly mechanical and think you might be interested in becoming a millwright, you should take high school courses in science, mathematics, mechanical drawing and machine shop practice.

People who want to become *industrial mechanics* need to take high school mathematics, mechanical drawing, blueprint reading and machine shop. They should have good mechanical aptitude and manual dexterity and be in good physical condition.

Both millwrights and industrial mechanics enjoy good working conditions. Both work indoors and are rarely affected by seasonal peaks or slumps. If there should be a slack time, many companies do major overhaul jobs on their machinery and thus avoid layoffs. Millwrights occasionally have to work overtime to meet construction schedules and may have to do the same in the event of an emergency.

Outlook for Millwrights

For information about wages, working conditions, unions and other questions you may have about these occupations, check with your instructor. Millwrights or industrial machinery people working in your area can also give answers to most of your questions. You can get their names from local businesses who hire them, or your counselor.

The future looks good for millwrights and industrial mechanics. Industry in the United States uses a tremendous amount of machinery and is likely to use more in the future. Increasingly, industrial machinery is automated and automatic machines must be controlled. Highly complex, automatic machines, require very special attention, and many manufacturers hire their own repair personnel and give them the training they need, free. The use of the computer in production control is opening whole new fields to those already-skilled workers. The prospects can be really exciting!

ELEVATOR CONSTRUCTORS (ELEVATOR MECHANICS)

Although elevator construction and maintenance is not a very large field, it is extremely important. With more multi-story office buildings and high-rise apartment buildings being built, and with

more escalators being put in, there is an increasing demand for elevator mechanics.

Elevator mechanics assemble and install elevators, escalators, dumb waiters and other equipment. They install new equipment in new construction and modify equipment in old buildings.

In new buildings they do their work as the construction is going on. Elevator mechanics usually direct the work of a crew of helpers. First, the crew installs the guide rails of the car in the elevator shaft, then installs the hoisting machines that will actually lift the elevator. Next, they build the car frame and platform, add the counterweight, install a chassis and the control panel. The cables are then strung and connected to the car frame and the counterweight. Next, the cab body and roof are put in and the control panel is wired. Last, the entire assembly is carefully checked, adjusted and tested.

Because constant improvements are being made in elevator construction, alteration work is frequently done. Even though an elevator may be operating without problems, alteration work can make the operation more modern and efficient. A new and modern chassis, cab body, roof and control panel are often used to replace the old parts.

The modern elevator is very complicated. Large motors drive complex arrangements of cables, pulleys and safety equipment. Cabs must be lighted, provided with music and air conditioned. Light sensors and safety bars prevent people or objects from being caught in the doors. Most elevators have emergency back-up equipment such as telephones or closed circuit television. Some even have pressurized cabs with auxiliary oxygen supplies to protect passengers when the building's carbon dioxide fire control systems are activated. All of this equipment requires connections to services located elsewhere in the building.

As we mentioned, there are not a great number of elevator mechanics. Because the work is specialized, not many firms are large enough to employ their own elevator mechanics. Most elevator mechanics work for elevator manufacturers and do installation, modernization and service work. There are a few contractors who specialize in elevator maintenance and repair, and some mechanics work for government agencies. Few elevator mechanics work as inspectors for government licensing and regulatory agencies.

Education and Training

The elevator mechanic is a highly skilled person. Surprisingly enough, training is informal. People generally begin as helpers. A helper normally must be at least 18 years old and be in good physical condition. Helpers should have good mechanical ability, a high school education or its equivalent and background courses in math and physics. In order to become a skilled elevator constructor, trainees must have at least two years of continuous job experience including a six-month, on-the-job training program at the factory of a major elevator firm. During this program, the trainee performs all the jobs of installing, maintaining and repairing elevators, escalators and other equipment that the factory makes. In addition, the trainee normally goes to evening classes taking math, physics, electrical and electronic theory and proper safety techniques.

Conditions and Opportunities

Working conditions for elevator constructors are generally good. Sometimes they must work in cramped or awkward positions, but because the work is indoors, constructors are protected from the elements and lose very little work due to seasonal factors.

Elevator constructors make some of the best wages in the construction trades.

There will probably never be a need for many elevator mechanics, but once established in the field you will almost always have a job. The demand for elevator mechanics is expected to increase during this decade because of the large increase in new industrial, commercial and tall residential buildings. Job openings for new workers will also result from transfers to other fields, retirements and deaths. With continued technological developments, as high speed elevators with automatic control systems, future mechanics will need more technical skill than in the past.

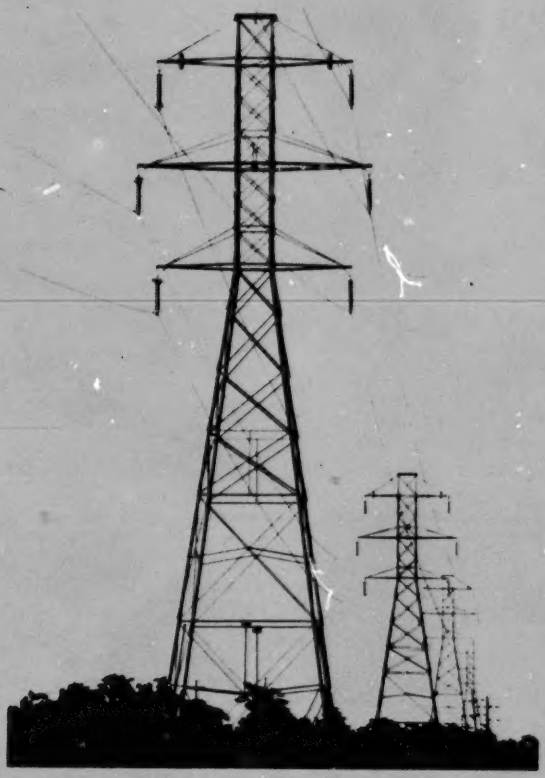
If this field interests you and you'd like more information, write to:

- International Union of Elevator Constructors
  12 South 12th Street
  Philadelphia, Pennsylvania 19107

INTRODUCTION TO CAREERS IN ELECTRICITY

It takes many people to form the team that gets electricity generated, transmitted, installed and maintained. From the apprentice electrician to the master engineer, designing electrical distribution systems which affect the lives of millions is the task of many people.

There are many job possibilities in the field of electricity. Don't single out one specific job now, and feel that this job is the only one for you. If you enjoy electricity, then there will be time later to narrow the field.



CONSTRUCTION ELECTRICIAN

A construction electrician receives a set of blueprints showing the electrical systems in a building under construction. The electrician then lays out, assembles, installs and tests the electrical fixtures, apparatus and wiring. Different electrical circuits include those for lighting the building, heating and air conditioning it, and enough power circuits to run whatever electrical apparatus might be planned for the building. In working on a single family residence, the electrical circuits are few and simple. An office building, a factory, a hospital or a school, requires more complex wiring setups.

The electrician analyzes a blueprint and the set of specifications telling which electrical components are to be used. According to the plan, the proper sized central load center, called a circuit box, is installed. It houses circuit breakers of the proper rating to protect the individual circuits from overloading. The proper rating is calculated, considering the appliances the circuit will service and in keeping with the National Electrical Code regulations.

After installing the circuit box, the circuits are laid out according to the plan. Conduit pipe or tubing may be used. Wire is pulled through the conduit to junction boxes and connected. When conduit is not used, holes are drilled through studs, rafters, plates or joists and the wire is strung through the power outlets and switches. It is secured to the walls with staples and connected or spliced into the system. After installation, the circuitry is inspected and tested.

Working Conditions

As a construction electrician you will probably wear a work uniform. This will depend upon the size of the contractor and company policy. Many larger contractors require, and some furnish, uniforms for their employees.

Most of the work is relatively clean. As a construction electrician you will work mostly on new construction. Only when your contractor takes on a remodeling job will you work on older buildings. Most of your work will be indoors and you will usually not be exposed to bad weather. You will sometimes put up outside lighting, but that will require a relatively small amount of time.

Construction electricians work regular daytime hours; there is no shift work or night work. Sometimes electricians travel a considerable distance to work and this may make the workday quite long. Usually they are paid for at least part of the travel time.

The construction electrician's work is not particularly hazardous. Like all construction workers, electricians risk falls, cuts and

bruises from falling objects and electrical shocks from malfunctioning equipment. Electricians are generally very safety conscious, and their accident rate is lower than that in most other construction work.

Outlook and Wages

Along with their good safety records, electricians also earn good money. Not only are the hourly wages among the highest, but construction electricians work in sheltered conditions and are rarely laid off because of weather. Entry level positions pay quite a bit less, so you will want to find out about wage rates in your locality before you plan a budget. Your instructor or counselor should have a good idea, or you might check with nearby union offices.

The job outlook for electricians is very good. The whole construction industry is growing and, therefore, the electrical trade is also growing. Remodeling old buildings keeps many electricians busy full time. Expanding services for new data processing equipment and other electrical controls is providing an expanding need for electricians.

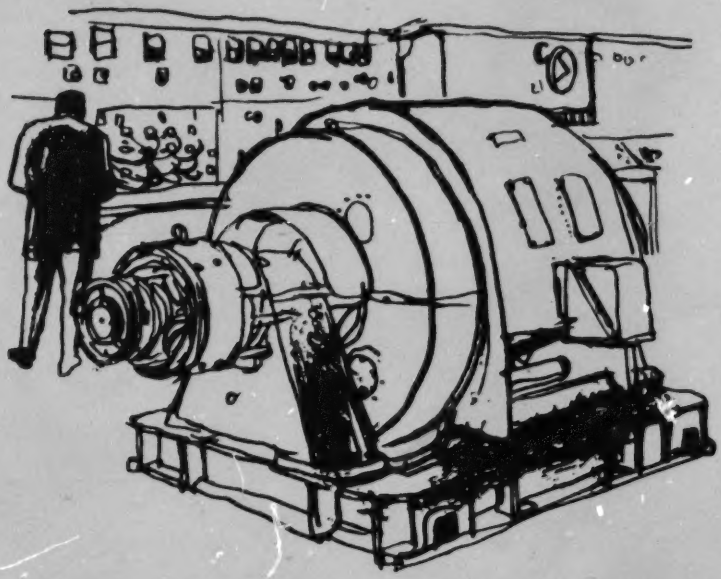
MAINTENANCE ELECTRICIAN

If you have read through the section on construction electricians, you have already discovered much about maintenance electricians, as their work is very similar. Just what does a maintenance electrician do?

Maintenance electricians' work varies from place to place. Although most maintenance electricians have about the same basic skills, the job each one does depends upon the particular industry and the size of the organization.

In a manufacturing plant, maintenance electricians usually maintain and repair electrical equipment used in making particular products. Steel mills and aluminum plants hire many electricians to maintain electrical and electronic equipment used to power and control rolling mills, presses and other production machinery. In industrial plants that use large amounts of electrical equipment, electricians usually specialize in maintaining one particular type of equipment.

In large office buildings, apartment houses and hospitals, the maintenance electrician keeps up the lighting systems, as well as other electrical equipment, as air conditioning systems.



The major part of the maintenance electrician's job is to prevent hazards, costly breakdowns and inconveniences. This work is called preventive maintenance. These may include such things as replacing switches, light fixtures, fuses, circuit breakers or coils.

The maintenance electrician also works from blueprints, wiring diagrams and sets of specifications, and may have to calculate the current-carrying capacities of circuits and the most useful working loads of equipment.

To do these jobs, the maintenance electrician uses hand tools such as wire cutters, pliers and screwdrivers, as well as other equipment such as test lamps, ammeters, volt-ohm meters and oscilloscopes to test electrical equipment and wiring. More and more cities and counties are requiring that maintenance electricians be licensed. An electrician gets a license by passing a comprehensive examination. This examination tests knowledge of electrical theory and its practical application.

Some of the non-manufacturing industries which hire maintenance electricians are transportation, communications and public utilities. Many maintenance electricians work for Federal, State and local governments. Most maintenance electricians work in heavily industrialized States such as California, New York, Pennsylvania, Illinois, Texas and Ohio, but they work in every other State as well.

Skilled workers are able to transfer to maintenance electrician jobs in different cities and in different industries. With some additional training, a maintenance electrician may qualify as a construction electrician.

Education and Training

Maintenance electricians work in a skilled profession, and there are some formal training requirements. Experts generally agree that formal apprenticeship programs give trainees more thorough knowledge of the trade and better chances for job advancement than informal on-the-job training.

Apprenticeship instruction includes mathematics, electrical and electronic theory and blueprint reading. In training, apprentices learn how to weld, braze, repair motors and install commercial and industrial wiring. They also learn how to install light and power equipment and, sometimes, how to install and repair electronic controls and circuits.

To become an apprentice you should possess better than average skill with your hands and be keenly interested in learning how electrical equipment functions. You also need good color vision because electrical wires are frequently identified by different colors. In addition, agility and good health are important, although great physical strength is not essential.

Changing demands for electrical goods and services require regularly increasing technical knowledge and new skills from all electricians. Maintenance electricians who entered the field years ago must now learn basic electronics in order to service the new electronic equipment being introduced in the nation's industries and large commercial and residential buildings.

Earnings of maintenance electricians compare favorably with those of other skilled workers.

Working Conditions

Working conditions vary greatly. During a single day, an electrician working in a plant may have to repair electrical equipment both in a clean air conditioned office and on a factory floor surrounded by noise, oil and grease of machinery. A maintenance electrician may have to climb ladders, work on scaffolds or work in awkward or cramped positions when repairing or installing electrical equipment. There is some risk of falls from ladders, cuts from sharp tools and electrical shocks, but most maintenance electricians do not find their jobs particularly hazardous.

DRAFTSMAN

You may wonder why the occupation of draftsman is included in a manual concerned with electrical occupations. Draftsmen are technicians who bridge the gap between scientists, architects, designers and engineers, and the skilled craftsmen. It is the draftsman who translates the ideas, rough sketches, specifications and the calculations of the scientists, architects, designers and engineers to complete accurate working plans for skilled craftsmen to use.

The electrical draftsman has specialized in electrical drawings. This person may have worked in other fields and later specialized in electricity, or may have begun as an electrical draftsman. Many companies, which need both types of draftsmen, will start trainees in electricity, because so many of the electrical symbols are available in templates, lettering machines, transfer symbols, tapes and other drafting aids.

There are four levels or classifications among draftsmen. These classifications indicate both the level of reponsibility and the nature of the work the draftsman performs.

- *Senior Draftsmen* — use preliminary information provided by scientists, designers and engineers to prepare design layouts.

Layouts are drawings of the object to be built and are drawn to scale.

- *Detailers* — make detailed drawings of each part shown on the layout. On these drawings, they give dimensions, specify materials and add any additional information that is necessary to make the detailed drawing clear and complete.
- *Checkers* — carefully examine drawings for errors in computing or recording dimensions and specifications. This requires very strict attention to detail.
- *Tracers* — work under the supervision of draftsmen, make minor corrections and prepare drawings for reproduction by tracing them on transparent cloth, paper or plastic film.

If you've found this interesting, you might already be raising questions about necessary qualifications. To become a draftsman, a person should be able to visualize objects in three dimensions, see spatial relationships and notice slight differences in visual matter. Such a person needs to be able to work with detail and have a high degree of finger dexterity. Also, to be a good draftsman one needs the ability and interest to understand the technical knowledge and theoretical principles involved in engineering, mathematics and related fields and be able to apply them in drafting work. Artistic ability is not generally needed, but it may be helpful in some specialized fields.

Education and Training

In training, you'll need the right background, including mechanical drawing and/or construction drafting courses. Take as many courses in mathematics and physical sciences as possible. You should take any courses dealing with electricity, including actual wiring methods and appropriate theory, since electrical drafting jobs require a thorough knowledge of methods. Finally, it would be helpful to have courses in structural design, strength of materials and physical metallurgy if your school offers them.

To get further training beyond high school, you will want to investigate the programs at technical institutes, community colleges, extension divisions of universities and correspondence schools. You might enter an on-the-job training program which, when combined with part-time schooling, would qualify you as a draftsman.

Outlook for Draftsmen

The possibilities for advancement are good. As draftsmen gain skill and experience, they may advance to higher level positions as

checkers, detailers, senior draftsmen or supervisors of other draftsmen. Some draftsmen go into business for themselves and become consultants or individual designers. Other draftsmen take courses in engineering and mathematics and become engineers.

Earnings and working conditions for electrical draftsmen are similar to those of other draftsmen. A draftsman's earning power depends upon education, training, ability and experience. Draftsmen, like most other technicians, can look forward to making more money as they move to higher positions.

Working conditions for draftsmen are usually very good. Due to the nature of the work, the office is well-lighted and usually air conditioned. Many times the surroundings are made quite pleasant in an effort to produce an atmosphere conducive to long periods of uninterrupted concentration and attention to detail.

TRANSMISSION AND DISTRIBUTION

One-fifth of all people who hold jobs with electrical light and power systems work in transmission and distribution. These people maintain the flow of electric power to its users. There are two kinds of workers in this field; those concerned with the flow of electricity and those who construct and maintain powerlines.

People who control the flow of electricity are substation operators and load dispatchers. The load dispatcher is a highly skilled and experienced person whose office is the nerve center of an entire utility system. Substation operators work under orders from the load dispatcher. They direct the flow of current out of their station by means of a switchboard. They also check the operating condition of all equipment and supervise the activities of other substation operators.

Those who build and maintain powerlines are line workers, troubleshooters, ground workers and cable splicers. A line worker replaces, repairs and maintains equipment.

Troubleshooters are experienced persons who work on special emergency crews. Like the load dispatcher, this is not an entry-level occupation.

Ground workers dig pole holes and help line workers and apprentices set up the poles, raise the wires and cables and install them on the poles. Ground workers require very little formal training.

Cable splicers install and repair single and multiple-conductor insulated cables on utility poles and towers, or in underground conduits. Most cable splicers get their training on the job.

ELECTRICAL ENGINEER

Engineering is the second largest professional occupation, exceeded in number only by those in teaching. Engineers are the people who devise ways to convert raw materials and sources of power into useful products, at a reasonable cost in terms of both time and money. They apply basic scientific principles in doing this. It is the emphasis on *application* of principles, rather than *discovery* of principles, that distinguishes the work of an engineer from that of a scientist.

What does an electrical engineer do? This person applies the laws of electrical energy and the principles of engineering to one or more of the several areas of the electrical field. This is called specialization.

Besides research, development and design work, electrical engineers are hired for administration and management, manufacturing operations, technical sales and teaching as well. All these jobs require a thorough knowledge of electrical engineering.

Education and Training

Most electrical engineers become engineers through formal education. Every State licenses or registers the engineers whose work could affect life, health or property, or who work for the public. Licensing requirements vary from State to State, but generally include graduation from an accredited engineering school, plus at least four years of experience and passing a State exam.

You should start preparing in high school by taking all the math and science possible. Ideally you should have two years of algebra, trigonometry, plane and solid geometry and analytics. Furthermore, you should take all the physics and chemistry you can. If your school has engineering drawing, try to take it.

Because the world is changing so rapidly, it is more important to be well-versed in general principles so that you can apply these principles to an ever-broadening field. Those whose field of specialization is narrow, will probably have a great deal of difficulty in finding and holding jobs in the future.

Salaries

Salaries of electrical engineers vary widely from place to place and depend on training and local demand. Generally speaking, engineers' entry-level earnings are higher than those of most other college graduates, and can expect to continue to make a good salary throughout a total career.

Electrical engineers generally work in quiet offices or research laboratories, although some do more active work outside on construction sites.

SUMMARY

The following additional sources can help to obtain more information if you are interested in the electrical field. First, be sure to check with your local public library or high school library.

For more information about electrical engineering you may write:

- Institute of Electrical and Electronics Engineers
  345 E. 47th Street
  New York, New York 10017
- Society of Women Engineers
  345 E. 47th Street
  New York, New York 10017

For information about construction electricity, write:

- International Brotherhood of Electrical Workers
  1125 15th Street, N.W.
  Washington, D.C. 20005
- National Association of Home Builders
  15th and M Street, N.W.
  Washington, D.C. 20005
- National Association of Women in Construction
  c/o Jack T. Holmes and Associates, Inc.
  2800 W. Lancaster
  Fort Worth, Texas 76101
- Associated General Contractors of America, Inc.
  1957 E Street, N.W.
  Washington, D.C. 20006
- National Electrical Contractors Association
  1730 Rhode Island Avenue, N.W.
  Washington, D.C. 20036
- National Joint Apprenticeship and Training
  Committee for the Electrical Industry
  1730 Rhode Island Avenue, N.W.
  Washington, D.C. 20036

For information about drafting, write:

- American Institute for Design and Drafting
  3119 Price Road
  Bartlesville, Oklahoma 74003

INTRODUCTION TO CAREERS IN MASONRY

In masonry, we group together the occupations that use masonry, clay products and masonry building systems as primary building, assembling and working materials. Specifically, masonry includes occupations such as brickmason, cement mason, plasterer, including marble and tile setters and terrazzo workers.

BRICKMASONRY

You have probably watched workers putting brick on a house being built in your neighborhood. You may have noticed a large commercial building such as a hospital, office building, church or school being built with brick, or you may have noticed a large warehouse being built with concrete blocks.

The first brickmason mentioned was putting brick veneer on a residence, the second was building brick walls and the third was constructing walls of cinder block. Each of these masons was working in a different phase of brickmasonry. All the brickmasons in the examples, however, were doing similar work using similar hand tools.

Brickmasons construct walls, partitions and such things as dividers and planters in lobbies and foyers of buildings. While building walls and other primary structures is by far the largest part of the brickmason's job, there is a trend toward using more ornamental brickwork in and around modern buildings. Brickmasons also build fireplaces and chimneys and occasionally work with other masonry materials.

BRICKLAYING

Before a brickmason builds something such as a wall, a check is made to see if the proper footing has been laid according to the specifications and blueprints. The mason is careful to make sure the brickwork is square and level so that doors, windows, vents, etc., will fit properly and accurately.

After careful planning, the brickmason is ready to begin work on the wall. The mason starts by constructing each corner, being careful to square, plumb and level them. A line is stretched horizontally from one corner to the other, just above the footing, and serves as a guide so that the first layer of bricks will be laid accurately. After the first course is laid, the line is raised. This process is repeated by raising the line each time a course is completed. In this manner the brickmason keeps the wall straight, level and plumb. Brickmasons do not usually have to mix or carry their mortar. This is normally done by hod carriers who move and set up scaffolding for brickmasons, in addition to mixing and carrying mortar.

CONCRETE BLOCK LAYING

Up to this point we've talked only about laying brick. Some brickmasons lay concrete or cinder blocks, which are relatively recent developments in brickmasonry. The blocks are neat and attractive, economical, fireproof, durable and have good acoustic properties. Because they are easy to manufacture and can be put up quickly and easily, there has been a very rapid increase in the use of cinder blocks.

Building a concrete masonry wall is similar in many ways to building a brick wall. The corners are laid first and carefully positioned. It is extremely important that each block be accurately placed if the wall is to be straight and true.

Laying a straight wall is not a particularly easy job. Doing it requires most of the basic skills needed by a brickmason. There are other things involved in being a brickmason. A brickmason needs to know the properties of mortar mixing machines and other equipment, and materials such as bricks, blocks, cement,

sand and lime. In addition, brickmasons need to know how to lay foundations and build steps, arches and columns. They must be able to plan and build fireplaces and hearths and to fireproof and waterproof structures. Occasionally, they lay glass block or artificial stone.

These are essentially the things brickmasons do. There are many variations and specialties within the field and much depends upon the size and type of contractor for which you would work. A very large contractor in a city often hires bricklayers who do only one kind of brickwork. In a small town, a bricklayer might be expected to build brick houses, commercial buildings of cinder block or fireplaces, and to make repairs on existing brick or cinder block structures. There is an almost endless variety of jobs in masonry.

If you find you like this kind of work you should be able to find a job that is right for you. You might work your way into a foreman's or bricklaying superintendent's job if you want more contact with people and less actual bricklaying. You could become an estimator and submit bids for bricklaying jobs, or you might decide to go into business for yourself by starting your own bricklaying contracting business.

To be a brickmason you need to be in good physical condition, although you need endurance more than great physical strength. You have to stoop, lift moderately heavy loads and stand for long periods of time. In peak work sessions, bricklayers often work long hours. Most of the work is done while standing out-of-doors. Good manual dexterity and an eye for straight lines and proportions are important assets for a brickmason.

Wages for Brickmasons

Hourly wages for brickmasons are among the highest in the building trades. A word of caution should be considered about hourly wages that seem unusually attractive. Remember that as a brickmason your salary would be $0.00 during bad weather because you wouldn't work. Also, straight time hourly earnings often do not include items as insurance, hospitalization, retirement and other fringe benefits.

As a brickmason, you will not get paid vacations unless you work for a large contractor. Sometimes your boss will make up for this by offering you higher hourly wages. You will want to find out about a company's vacation, retirement and insurance provisions when asking about a job.

Education and Training

Many training experts suggest that the best way to learn brickmasonry is through a formal apprenticeship program. Applicants for apprenticeships must be between 17 and 24 years of age. A high school education or its equivalent is desirable, and in some cases necessary for acceptance. Also, you might be required to take some tests to find out if you have the necessary aptitudes for masonry. When you become an apprentice, you will work with an experienced brickmason, first observing, then actually being taught bricklaying.

Some recent technological developments are expected to reduce the demand for brickmasons. Other developments, such as high-strength mortars that can be applied with caulking guns, have increased the efficiency of brickmasons and thus may cut down the number of masons needed to do a given job.

If you want more information you should talk to your instructor or counselor, check in your library or write to:

- Associated General Contractors of America, Inc.
  1957 E Street, N.W.
  Washington, D.C. 20006
- Bricklayers, Masons and Plasterers
  International Union of America
  815 15th Street, N.W.
  Washington, D.C. 20005
- Brick Institute of America
  1750 Old Meadow Road
  McLean, Virginia 22101

CEMENT MASONRY

There are many sorts of concrete finishing. You might make concrete stepping stones or benches or even build a patio or some sidewalks. Perhaps you've watched a freeway being built through your town where large concrete highways were laid. Or maybe you've seen concrete overpasses or bridges being built with large concrete beams that were made elsewhere and hauled to the site. All of these jobs require the work and skills of the concrete finisher. The concrete finisher has a major role in the construction of foundations and walls for modern skyscrapers, and the building of huge dams.

As a concrete finisher, you would learn a great deal about the materials used in making concrete. You would know which type

of cement is best for each type of job, what ratio of cement, sand and gravel would be best to use in order to get concrete of a desired strength, and you would be able to recognize poor quality materials. You would be able to tell about how much water a given job would require, after considering the effects of the heat or the cold and the wind. As an experienced concrete finisher, you would be able to determine whether the concrete is curing properly, by looking at it or feeling it.

These are some things you'd actually do if you were a concrete finisher. There are some other aspects of the job that may or may not be obvious. First, being a concrete finisher is hard, stranuous work. It requires physical strength as well as endurance. When concrete is poured, it must be worked until it is finished. You can't quit work at 5 o'clock and come back the next day to finish it. Most of the work done on concrete is done on floors or other flat surfaces. This requires a great deal of kneeling, bending and stooping. In addition, most of the work of a concrete finisher is out-of-doors, and concrete can be worked in fairly bad weather.

In concrete finishing, as in most other construction work, the range of your responsibility will be determined by your desire, how long you've been with the contractor and the size of the contracting firm.

Wages for Concrete Finishers

The pay for concrete finishers is slightly below the average for all journeymen in the building trades. When considering a job you should find out what the average annual salary would be and what fringe benefits go with it.

Because wages vary so much from one part of the country to another, it is hard to state an entry level wage for concrete finishers. Your instructor will know what the entry level wages are in your locality.

Many workers now in the field began by going to work as laborers. They acquired their skills informally by assisting other concrete finishers. This method of becoming a concrete finisher is not as popular, or as successful, in today's world as it has been in the past.

Education and Training

Many people think that a formal apprenticeship program is the best way to get the knowledge and skills needed to be a concrete finisher. To be accepted in an apprenticeship program, you need to be between 18 and 30 years of age, have a high school education, be in good physical health and have good manual

dexterity. In the training, you will learn applied mathematics, related sciences, blueprint reading and architectural drawing. You will learn how to estimate materials and costs, and in some apprenticeship programs you'll learn local building regulations.

No matter how you choose to get your training as a concrete finisher, you can strengthen your background by working into your high school program such courses as math, algebra, geometry, mechanical drawing and blueprint reading.

If you want more information about the field, write to:

- Associated General Contractors of America, Inc.
  1957 E Street, N.W.
  Washington, D.C. 20006
- Bricklayers, Masons and Plasterers' International Union of America
  815 15th Street, N.W.
  Washington, D.C. 20005
- Operative Plasterers' and Cement Masons' International Association of the U.S. and Canada
  1125 17th Street, N.W.
  Washington, D.C. 20036

PLASTERING

Plastering is one of the most diverse fields in the construction industry. Once considered almost dead, the work of plasterers has changed dramatically.

A plasterer is a person who coats the interior walls and ceilings of buildings with a white substance which, when dry, forms hard, durable walls and ceilings. Walls and ceilings of plaster are also fire resistant and relatively sound-proof. Plaster is usually made with gypsum, lime or Portland cement, certain clays and other building materials and enough water to make mud. Plasterers also use a durable type of cement plaster or stucco to do exterior walls.

The range of duties of a plasterer vary widely. If you were to work for large contractors, you might be a crew member or a crew leader. As a beginner, you would probably be mixing and carrying materials for the more experienced plasterers; or you might be required to disassemble, move and reassemble scaffolding for the journeymen.

As a plasterer, you would usually work a 40-hour week. If you were required to work overtime, you would receive premium pay.

Sometimes you might have to drive a considerable distance to the job, but usually the contractor pays for this.

Wages vary widely from area to area. It is difficult to say what the average entry-level wage is. Your instructor knows entry-level wages for your community.

Education and Training

As with most other jobs in construction, there are several ways to get into the field. Many plasterers now working, learned their skills informally on the job by observing, helping and being taught by experienced plasterers. There are courses, some in vocational trade schools, which teach young people plastering.

Many persons think that the best way to learn plastering is through a formal apprenticeship program. To become an apprentice you generally need to be between 17 and 25 years of age, in good physical condition and possess good manual dexterity.

On-the-job training teaches the apprentice such things as the proper use and care of tools, characteristics of the different materials used, the proper means of applying various plastering

materials. The apprentice learns how to align and plumb walls, apply all the popular finishes (including textured finishes) and lay out various kinds of plastering jobs as arches, ceilings and ornamentals.

In the classroom, an apprentice learns drafting, blueprint reading and mathematics related to his work. He will also learn how his work relates to the other building trades. You can strengthen your background for plastering while still in high school by taking math, blueprint reading and other courses as recommended by your instructor and counselor.

If you want more information about plastering, you should talk to your instructor, counselor, state employment service or write to:

- Bricklayers, Masons and Plasterers' International Union of America
  815 15th Street, N.W.
  Washington, D.C. 20005
- International Association of Wall and Ceiling Contractors
  1775 Church Street, N.W.
  Washington, D.C. 20036
- International Council for Lathing and Plastering
  221 North LaSalle Street
  Chicago, Illinois 60601
- Operative Plasterers' and Cement Masons' International Association of the U.S. and Canada
  1125 17th Street, N.W.
  Washington, D.C. 20036
- National Plastering and Industry's Joint Apprenticeship Trust Fund
  1000 Vermont Avenue, N.W.
  Washington, D.C. 20005

MARBLE SETTING, TILESETTING AND TERRAZZO WORKING

In the group of jobs described in this section, the work performed is covering the interior and exterior walls and/or floors with marble, tile or terrazzo.

Marble Setting

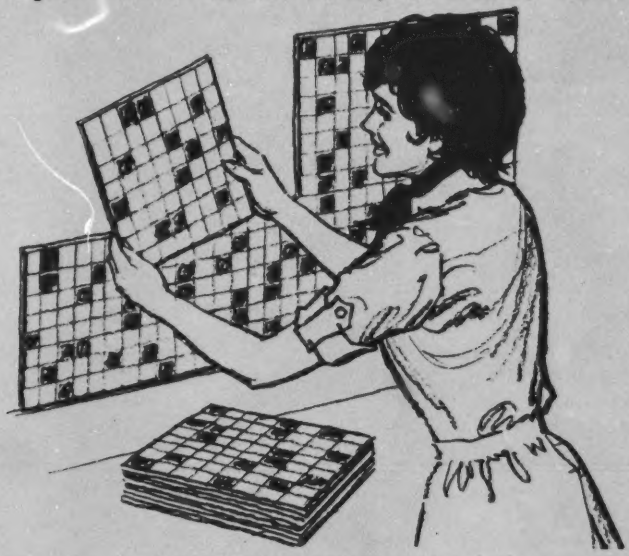
Marble setters are people who install marble or artificial marble panels in buildings. They may also install panels of shop-made terrazzo or structural glass. Regardless of whether the marble setter is installing marble or glass, the panels come to the job

already sized and polished, ready to be fitted into place. When the panels arrive at the work site, the marble setter lays out the work according to blueprints and specifications. Most of the time the panels will require, at most, a small amount of cutting and fitting.

Tilesetting

Tilesetters cover walls, floors or ceilings with tile. Tile is a thin slab of baked clay, stone or other material, usually about 3/8 of an inch thick and either 4-1/4 or 6 inches square.

There are a number of different types of tile. The most common type is glazed ceramic tile, used in many homes today in shower



stalls or around bath tubs. Another type, that most people are familiar with, is dark red floor tile often used in entrance-ways of buildings. The entrance foyer of some homes has this type of floor tile also. Another common tile is the one used on the floors of the restrooms of most commercial buildings.

Terrazzo Working

Terrazzo workers do all the jobs necessary to make terrazzo floors. Terrazzo is a type of ornamental concrete which is laid in much the same way as concrete, but is then ground smooth and polished after hardening. Instead of using gravel, marble chips are used so that when the surface is ground down, the marble is exposed.

These descriptions give a brief explanation of the type of work that you would do if you worked in one of these occupations. These three occupations are grouped together, because they are all finishing-type masonry jobs and they all produce hard, durable surfaces.

If you become a marble setter or terrazzo worker, your work will be both indoors and outdoors. If you become a tilesetter, you will work almost exclusively indoors. This can be an important consideration. If you have a construction job where you work outdoors, there will almost certainly be days that you can't work because of bad weather. As a worker in one of these occupations, you will usually work regular daytime hours, weather permitting, a typical 40-hour week. You will seldom be required to work overtime, but you will be paid premium wages in the event that you do.

As always, there are areas of the country where wages will be high; others low. Because wages vary so greatly from one part of the country to another, it is hard to list entry-level wages for these jobs. Your instructor can probably help you find out about the wage scales in your area.

Many people who now work at these occupations acquired their training informally by working as helpers and being taught by experienced personnel. However, a formal, three-year apprenticeship program is recommended by some training experts as the best way to learn these occupations.

Classroom instruction includes blueprint reading, layout work, basic mathematics, shop practice and safety. The on-the-job training includes proper use and care of the tools of the trade, the selection and use of materials according to the specs of a job and development of many diverse skills required.

If you want more information about the work of marble setters, tilesetters or terrazzo workers, you can write:

- International Association of Marble, Slate and Stone Polishers, Rubbers and Sawyers, Tile and Marble Setters' Helpers and Marble Mosaic and Terrazzo Workers' Helpers
  821 15th Street, N.W.
  Washington, D.C. 20005
- National Terrazzo and Mosaic Association, Inc.
  716 Church Street
  Alexandria, Virginia 22314
- Tile Contractors Association of America, Inc.
  112 N. Alfred Street
  Alexandria, Virginia 22314

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ABSTRACT: THE PURPOSE OF THIS INSTRUCTOR'S GUIDE IS TO OUTLINE A SERIES OF TRAINING EXPERIENCES RELATED TO WORKING WITH WOOD THAT CAN LEAD A STUDENT TO AT LEAST ENTRY-LEVEL JOB PROFICIENCY. THE GUIDE IS DIVIDED INTO SEVERAL TEACHING UNITS, EACH WITH AN OVERALL OBJECTIVE. THERE ARE FURTHER DIVISIONS LISTING SUBOBJECTIVES WHICH, WHEN SUCCESSFULLY COMPLETED BY THE STUDENT, WILL SATISFY THE OVERALL OBJECTIVE FOR A SPECIFIC UNIT. SUGGESTED ACTIVITIES ARE LISTED UNDER THE SUBOBJECTIVES AND ARE SUPPORTED BY A NUMBER OF TEXTS. SOURCES OF INFORMATION AND AN OUTLINE OF "ACADEMIC RELATED THEORY AND INFORMATION" ARE ALSO INCLUDED IN EACH UNIT. UNIT TITLES FOR THIS GUIDE ARE: FORMING, FRAMING, TRIMMING AND SIDING, FLOORING, AND ROOFING. THIS DOCUMENT SHOULD BE USED IN CONJUNCTION WITH THE STUDENT MANUAL FOR WOOD (VT 102 408 IN THIS ISSUE). (AUTHOR/LJ)

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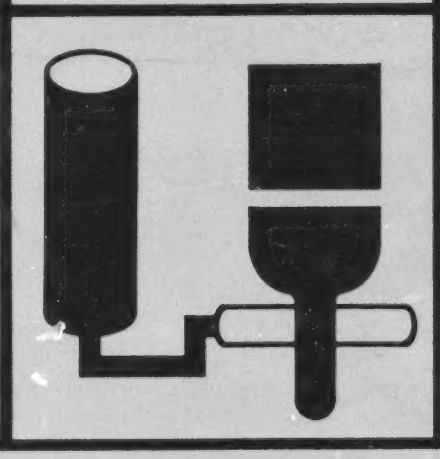
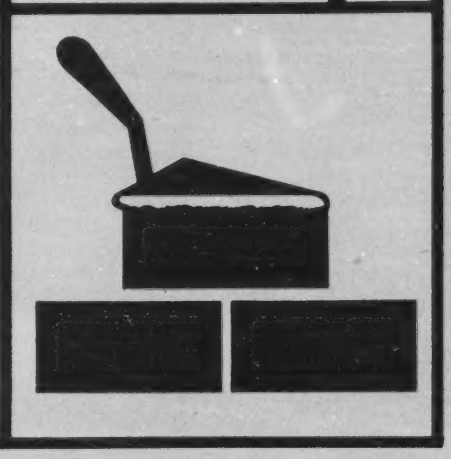
WOOD





construction industry series
instructor's guide
preparation level

VT 102 407

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AUSTIN, TEXAS
1975

This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

EXPLORATION LEVEL:

Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

OCCUPATIONAL PREPARATION LEVEL:

Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
Metal - Student Manual
Metal - Instructor's Guide
Electricity - Student Manual
Electricity - Instructor's Guide
Masonry - Student Manual
Masonry - Instructor's Guide

In addition, there is an Articulation Guide designed for these instructional materials in construction.

Articulation Guide - Construction Industry Series

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INTRODUCTION TO WOOD OCCUPATIONAL PREPARATION

PURPOSE

The purpose of this guide is to outline a series of training experiences that can lead a student to at least entry-level job proficiency. The instructor guide is divided into several teaching units, each with an overall objective. There are further subdivisions listed as sub objectives which will satisfy the overall objective for a specific unit when successfully completed by the student. Suggested activities are listed under the sub objective and are supported by a number of texts.

Use of behavioral objective format may or may not be new to you. There are a few basic components which acceptable behavioral objectives must include. First, all behavioral objectives must be directed toward student performance. Second, they must clearly state action or behavior which a student must perform. Third, there must be some criteria by which you can measure the success or failure of that action or behavior.

The establishment of a series of measurable goals for each student can individualize the education and training process. If a student can demonstrate skill in certain basic tasks to the satisfaction of the instructor, the student can move on to tasks which are more challenging. Instructing all of your students in the performance of a task, in which many of them are already proficient, can severely affect enthusiasm and motivation. This problem can, in large part, be overcome by the use of a pretest designed to provide a beginning point from which the student can start his or her training. The systematic use of planned instructional outcomes (behavioral objectives) can serve to more effectively motivate students.

The instructor's guide makes no attempt to set down absolute standards defining successful student performance. It will be your responsibility to establish these performance levels for your students. Some performance standards, such as working safety, should probably be set at the 100 percent level. Your professional judgment, and the abilities of your individual students, provide the basis for determining the standard which students must meet before proceeding to another task objective.

PROGRAM APPROACH AND TECHNIQUE

During the exploratory phase of the Construction Program, students are encouraged to explore several job families in construction. As they enter your class, they have made a more refined choice and should now be prepared to develop a number of specific skills.

To accomplish the purpose of this program, a two-fold approach has been taken. The material has been organized into two distinct components -- Instructor's Guide and Student Resource Manuals.

The Instructor's Guide is organized into a task-by-task outlining of suggested activities structured around behavorial objectives.

LESSON PLANNING

Organization and planning are essential to the success of any program. The four-step lesson plan recommended procedure is:

Step 1 Preparation of the Lesson. Applying the principle of Readiness, the instructor should prepare students for the lesson. Information sheets, reading assignments in the text and Student Resource Manual and other introductory techniques can help to prepare the student.

Step 2 Presentation. Applying the principle of Effect, the instructor should present and demonstrate a given process or activity supported by media and selected student involvement. Tell and show how to do the task step-by-step, citing critical check points and special safety requirements.

Step 3 Application of student performance. Applying the principle of Practice, the instructor should permit the students to do the assigned task. Special work sheets, drawings and instructions should be provided the student when necessary.

Step 4 Performance test. Applying the principle of Criteria, referenced testing is used to determine student performance at acceptable levels. Those students who do not meet acceptable performance standards are cycled through Steps 2, 3 and 4 again.

(See Appendix, Sample Lesson Plan)

STUDENT RESOURCE MANUAL

The Student Resource Manual is intended to serve as a supplemental text and information manual. It is designed and written for student use and it is structured to compliment the Instructor's Guide. Subjects such as tools and equipment, materials, processes and safety are discussed. A glossary of terms is included in each student manual.

The success or failure of a preparation program can depend on many things. It is hoped that you will encourage student participation in youth organizations which promote scholarship and craftsmanship. VICA organizations have been very successful in motivating and recognizing student accomplishments. If your school does not have a VICA chapter, you can be instrumental in starting one. The rewards to the community, school, and especially the student, can be readily apparent. Other student organizations, such as DECA, may be of interest to students aiming for careers in the wholesaling and retailing of construction products.

Of further value to your program would be the establishment and maintenance of a strong advisory committee. The involvement of members of the community can help to promote your program. A committee of this kind can form a solid bridge between school and community. If your school does not have a construction advisory committee, it is time to start one. The exchange of ideas can benefit both the school and community.

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FORMING

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to stake out and erect batter boards for a building.

SOURCES OF INFORMATION

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals

Communication Skills

- Student Resource Manual
- Vocabulary Development

WOOD

CONTENT TITLE: Batter Boards

SUB OBJECTIVE 1: The student will demonstrate ability to erect batter boards for a building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates erecting batter boards.

A. Drive outside stakes far enough outside building lines so they will not be disturbed during excavation. Position to form lines parallel to proposed building lines.
B. Nail boards to stakes at a specified elevation to form an "L", the arms of which are parallel to building lines.
C. Position cords over and along proposed building lines.
D. Locate cords directly over lines through corner hubs by holding plumb bobs over hubs and touching cords to bob line.
E. Nail lines to boards.
F. Mark batter boards as to elevation information, line information, etc. on each batter board.

II. Students erect batter boards.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to build forms for concrete footings.

SOURCES OF INFORMATION

Durbahn, Walter E., Fundamentals of Carpentry, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Lux, Donald G., and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Mix, Floyd, Practical Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1963.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Scale measurements
- Material and tool sizing
- Degrees and angles

Communication Skills

- Blueprint reading
- Working drawings
- Symbols
- Student Resource Manual
- Related safety - working with concrete

WOOD

CONTENT TITLE: Footings

SUB OBJECTIVE 2: The student will demonstrate ability to build and pour concrete footings for basements.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building and pouring footings for basements.

A. Stake out site or square site for foundation footings.
B. Excavate soil to form a mold for concrete wall footing (example 1'4" x 10").
C. Demonstrate using all earth forms, with no wood.
D. Demonstrate tying steel for footings outside of earth forms.
E. Tie three #4 continuous main longitudinal reinforcement bars and anchor them to stirrups.
F. Pass stirrups under bottom of longitudinal steel to prevent lateral slippage.
G. Use stirrups to tie all splices together with a two foot lap, or splice, to resist all diagonal tension.
H. Place steel into earth form. Support steel on bolsters to hold off the ground during pouring.
I. Moisten earth thoroughly before placing concrete on earth forms.
J. Demonstrate depositing concrete into even horizontal layers; do not puddle or vibrate into place.
K. Demonstrate working concrete around reinforcing bars.
L. Demonstrate screeding.
M. Demonstrate placing a 2 x 4 in center of footing for a keyway. The keyway is formed by pressing the 2 x 4 into the concrete (about 2") before it has set and removing it after the concrete has set.
N. Leave surface of concrete rough for wall sections.

II. Students build and pour footings for basements.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to build forms for slabs.

SOURCES OF INFORMATION

Durbahn, Walter E., Fundamentals of Carpentry, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Lux, Donald G., and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Computing square and cubic measurements

Communication Skills

- Related safety - working with power tools
- Student Resource Manual

WOOD

CONTENT TITLE: Slabs

SUB OBJECTIVE 3: The student will demonstrate ability to build, check and inspect forms for a house slab.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building, checking and inspecting forms for a house slab.

A. Drive stops for studs or braces into ground before excavation of beam; then slab will be along edge of earth excavation of exterior beams.
B. Nail "two by" planks or 3/4" plywood sheathing onto studs to serve as sheathing for wall forms.
C. Set string elevation and level. Use surveying instruments to set and check grade line of batter boards.
D. Check elevations at all corners with surveying instrument. Drive braces down to required elevation of finished slab.
E. Set form around porch, leaving retainer for main slab. In this way, mortar can be forced under main slab retainer to join porch mortar.
F. Demonstrate nailing bracing.
G. Demonstrate constructing stake bracing so that it will withstand impacts from dumping concrete, starting and stopping concrete vibrator, etc.
H. Build forms up around slab to a height of 8" above highest ground line with crushed stone or fill sand 5" below finished slab elevation.
I. Check exterior beam depth and excavate to a depth of 30" (or to bedrock) below top of form.
J. Demonstrate setting 2 x 6's for brick ledges. (The 2 x 6 is layed edgeways with its top surface level with floor elevation.)
K. Demonstrate setting 2 x 4's for 3-1/2" or 1-1/2" garage floor drops. Indicate required garage slab slope in forming using duplex nails.
L. Set door lip or drop in garage floor for garage door. (Check door manufacturer's specifications for required lip.)

Continued ...

CONTENT TITLE: Slabs (Continued)

SUB OBJECTIVE 3: The student will demonstrate ability to build, check and inspect forms for a house slab.

SUGGESTED ACTIVITES: (Students and Teachers)

M. Set approach ramp to garage door.
N. Demonstrate setting "two by" forming for all recessed areas in slab floor to a depth of recess.

II. Students build, check and inspect forms for a house slab.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to build forms for walls and ramps.

SOURCES OF INFORMATION

Durbahn, Walter E., Fundamentals of Carpentry, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Lux, Donald G., and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Mix, Floyd, Practical Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1963.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Material estimation
- Review math requirements for job entry or higher education

Communication Skills

- Catalog usage
- Vocabulary development
- Related safety
  - Building ramps and scaffolds
  - Salvaging forming materials
- Review communication skills required for job entry or higher education
- Review career and education possibilities
  - Apprenticeship
  - Job
  - Higher education

WOOD

CONTENT TITLE: Basement Walls

SUB OBJECTIVE 4: The student will demonstrate ability to develop walls for a basement.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building the outside form for the walls of a basement.

A. Nail shoe plate into foundation or footing.
B. Nail studs to shoe plate, and space studs according to load and height of wall.
C. Run studs vertically to wall forms.
D. Nail 3/4" plywood sheathing to studs. Make watertight and as smooth as possible.
E. Nail whales (When studs exceed 5' height) horizontally to studs; lap at corners. Place bottom whale as near the bottom as possible. Use whales on prefabricated panels to straighten them if desired.
F. Nail bracing. A common type of nailing pattern is a 2 x 4 nailed from a stake to a stud or whale, at a 30° angle to the horizontal.
G. Stake bracing. Bracing should withstand the sideways impact of dumping concrete or of other impacts such as starting and stopping concrete vibrators, etc.

II. Students develop wall forms for a basement.

WOOD

CONTENT TITLE: Walls

SUB OBJECTIVE 5: The student will demonstrate ability to frame a non-earthform basement wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building forms and completing form walls for a basement.

A. Erect outside walls; erect inside walls similarly. Check all elements of walls for rigidity and strength.

B. Cut and drill required number of spreaders for forms. (Spreaders are small, wooden blocks, as long as the width of the wall, with a hole drilled through the center for a wire.)

C. Position lower course of spreader blocks (level) as high as the first pour will be deep from the bottom. Attach along wire.

D. Position similarly other courses of spreaders, running the wire from the lower spreader through the hole. Leave 3 to 4 feet of wire free at top of form to allow spreaders to be pulled out.

E. Position tie wires alongside spreaders. Tie one side to waling, loop across and through forms and wrap around a piece of pipe, bolt, etc. Twist until wire is taut.

F. Position grade nails as required.

G. Demonstrate positioning bedding for fixtures or pipe as required.

II. Students frame a non-earthform basement wall.

WOOD

CONTENT TITLE: Ramp Construction

SUB OBJECTIVE 6: The student will demonstrate ability to build a ramp structure.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building ramp structures for pouring concrete.

   A. Mention that platform and ramp structures should be constructed so as to be independent of form work.
   B. Emphasize that ramps must be designed for easy portability so they may be moved as concrete is placed.
   C. Demonstrate building runway supports, cross braces and footing for runway planks.
   D. Demonstrate placing planks for a runway. Build wide enough for two wheelbarrows.
   E. Occupational Safety Health Act requirements for elevated structures.

II. Students erect ramp and platform structure for pouring concrete.

WOOD

CONTENT TITLE: Form Treatment

SUB OBJECTIVE 7: The student will demonstrate ability to treat forms with form release compound.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates treating forms with various form-release compounds.

A. If forms are to be used repeatedly, paint them for protection.
B. Demonstrate treating form with form oil or other coating material.
C. Demonstrate treating with a penetrating coating to prevent form from absorbing water and causing sand streaking.
D. Discuss merits of treating with shellac when a low grain rise is desired.
E. Emphasize that columns and wall forms should be oiled before being erected; other forms may be treated when convenient but must be treated before reinforcing steel is positioned.

II. Students treat forms with form release compounds.

WOOD

CONTENT TITLE: Salvage

SUB OBJECTIVE 8: The student will demonstrate ability to remove, clean and salvage form materials.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates removing, cleaning, salvaging and storing form materials.

A. Remove forms in reverse order.
B. Use care in prying form material from concrete surface so as to avoid damaging concrete surface.
C. Use caution when removing nails from form wood and when removing materials from site.
D. Salvage as much of the form materials as safely possible, discarding all split and broken braces and stakes.
E. Remove form material from the patio, steps or porch, sidewalk and driveway.
F. Scrape and brush concrete from form lumber in clean-up operation.
G. Remove form ties a few days after forms have been removed. Remove ties by twisting and pulling on the tie so that it breaks off beneath concrete surface.
H. Grout tie holes.
I. Treat forms with a penetrating oil coating to preserve them for future use.
J. Store form materials outside on wooden blocks or boards to keep them off the ground.
K. Stack materials properly and safely.

II. Students strip, clean and store forms.

FRAMING

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to use safely power equipment to build and assemble girders, beams, posts, etc., to install termite shields and to fabricate and attach sills to basement foundation walls.

SOURCES OF INFORMATION

Durbahn, W. E., Fundamentals of Carpentry, 4th revised ed., (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Lux, Donald G., and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 60701), 1970.

Mix, Floyd M., ed., Practical Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1963.

Standard Construction Details, (Standard Homes Co.: Colorado Building, Washington, D. C. 20002).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Decimals
  - Fractions
- Material and tool sizing
- Level and plumb

Communication Skills

- Related safety - power tool operation
- Student Resource Manual
- Blueprint reading
- Vocabulary development

WOOD

CONTENT TITLE: Foundations and Sills

SUB OBJECTIVE 1: The student will demonstrate ability to use power equipment safely.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates safety in using power equipment.

A. Demonstrate changing drill bits in electric drill.
B. Demonstrate using a power drill to drill hole in sill plates.
C. Demonstrate safety in changing the saw blade on a radial arm saw.
D. Demonstrate safety in using a radial arm saw.
E. Demonstrate safety in changing the saw blade on a table saw.
F. Demonstrate safety in using a table saw.
G. Demonstrate safety in using general carpenter's tools.
H. Demonstrate safety in driving a 16d nail and toe-nailing 8d.
I. Demonstrate safety in driving steel nails into concrete.

II. Students practice cutting and nailing safely.

CONTENT TITLE: Foundations and Sills

SUB OBJECTIVE 2: The student will demonstrate ability to build and anchor girders, beams, posts and columns for floor frames.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building and anchoring girders, beams, posts and columns.

A. Discuss use of girders, beams, posts and columns.
B. Demonstrate calculating loads for each.
C. Demonstrate use of tables to determine proper size.
D. Select materials.
E. Use blueprints to show locations of each.
F. Explain various methods of fastening and anchoring.

II. Students build girders, beams, posts and columns.

WOOD

CONTENT TITLE: Foundations and Sills

SUB OBJECTIVE 3: The student will demonstrate ability to place termite shields.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates placing termite shields.

A. Measure and drill holes in 24 or 26 gauge galvanized termite shield with a 45° angle on each side for outside beam of basement.
B. Install termite shield over anchor bolts and use an 18" 2 x 4 to push it down against foundation. Use tar or grout to seal around bolts. Also, use bolts that are too big for for the holes. This will improve the seal.
C. Place a 3/8" layer of grout or mortar over shield and level to top of foundation for a 2 x 6 sill plate and weather sealer.
D. Place termite shields around top of all columns.
E. Place termite shields around all pipe going through subfloor.
F. Emphasize that electricians, plumbers and carpenters mouse-proof all holes into foundation area.

II. Students install termite shields.

WOOD

CONTENT TITLE: Foundations and Sills

SUB OBJECTIVE 4: The student will demonstrate ability to place sill plates on basement foundation walls.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates placing sill plates on basement foundations.

A. Select 2 x 6 materials and measure and drill holes in sill plate for basement anchor bolts.
B. Lay 2 x 6's against bolts and mark holes to be drilled. Sill should be set back from outside edge to allow for siding. Use a caulk line to make inside measurement.
C. Demonstrate that location for each bolt should be measured because of difficulty in setting bolts in concrete.
D. Drill holes 1/8" larger than diameter of bolts in sill plate.
E. Place sill over anchor bolts around exterior of foundation beam.
F. Place a 3/8" layer of grout or mortar over shield and level to top of foundation for a 2 x 6 sill plate, weather sealer and 30 pound felt paper between grout and plate.
G. Snug anchor bolts down on sill plate with termite shield. Do not crush 2 x 6 with anchor nut and washer.
H. Cut sole plate lengths to form corners and lengths for walls. Be sure to square both ends.
I. Shim or wedge sill plate where necessary to keep it level, using a transit to level sole plate if necessary.
J. Check outside measurements of sole plate to conform to plan diameter.
K. Demonstrate different types of sill construction used.

II. Students place sill plates on basement foundation.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to fabricate and install floor joists, frame openings in floors, lay subfloors, install bridging in floors and to attach sills to slab foundation-type flooring.

SOURCES OF INFORMATION

Durbahn, W. E., Fundamentals of Carpentry, 4th revised ed., (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Lux, Donald G., and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Mix, Floyd M., ed., Practical Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1963.

Standard Construction Details, (Standard Homes Co.: Colorado Building, Washington, D. C. 20002).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Using a framing square
- Degrees and angles
- Scale measurements

Communication Skills

- Making working drawings
- Student Resource Manual
- Manufacturer's literature

WOOD

CONTENT TITLE: Floors

SUB OBJECTIVE 5: The student will demonstrate ability to install floor joists over basement walls and columns.

SUGGESTED ACTIVITES: (Students and Teachers)

I. Instructor demonstrates installing floor joists over a basement.

A. Demonstrate using plan to obtain information regarding size of floor joists and proper spacing, checking charts to conform to stress loads.
B. Cull floor joist material for bad lumber, knots and warped boards.
C. Demonstrate methods of recognizing a "crown" and discuss making use of crowns by making each joist for direction of crown.
D. Cut joist material to total span length less 3" for header joists. Square both ends.
E. Lay out floor joists in equal spaced units of either 12", 16", or 24".
F. Construct a built-up girder out of two 2 x 6's nailed together to support the floor joists; this is placed near center of basement, on columns, with a 2 x 4 ledger nailed on each side; this unit is to support the floor joists.
G. Splice and lap floor joists over girder or use iron stirrups or joist hangers in splicing floor joists, when span is greater than material length available.
H. Position floor joists on sill and girder with crown up.
I. Nail lap joist together, and toe-nail floor joist to sill plate and girder.
J. Saw, place and nail header joist on outside of floor joist. Cover end sections of floor joist cut 1-1/2" short on each end of overall diameter.
K. Place double joists under partition or load bearing walls.
L. Check spacing of joists. Use nailer strip in center of joist to ensure correct line up.

II. Students install floor joists over a basement.

WOOD

CONTENT TITLE: Floors

SUB OBJECTIVE 6: The student will demonstrate ability to cut and install bridging struts.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates cutting and installing bridging.

A. Demonstrate using 1 x 4 struts, solid bridging and metal bridging.
B. Demonstrate why cross bracing is superior to solid bracing because of fitting requirements.
C. Demonstrate constructing cross bridging of transverse rows of small diagonal bracing.
D. Point out that cross bridging helps prevent warping and stifling of the floor joist.
E. Demonstrate using plans for locating bridging across floor joists and inserting rows of cross bridging from 5 to 8 feet apart.
F. Mention that cross bridging is most effective if placed in straight lines extending the entire length of the floor plan.
G. Use a framing square to determine angle and length of struts and for measuring from top to bottom of two plumb joists.
H. Demonstrate cutting 1 x 4 material for cross bridging struts.
I. Demonstrate safety in cutting length of struts with a radial arm saw.
J. Demonstrate safety in cutting angle and width of struts with a table saw or radial arm saw.
K. Set up a chalk line and snap a line on floor joists at position for bridging. On long distances, have someone in the center.
L. Nail two nails in each end of cross bracing before placing them between joists.
M. Nail only top of struts first, until floor joists have had time to adjust to themselves.
N. Nail bottom of bridging after floor decking is placed and nailed to floor joists.

II. Students cut and install bridging.

WOOD

CONTENT TITLE: Floors

SUB OBJECTIVE 7: The student will demonstrate ability to frame a floor opening.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates framing a floor opening.

A. Discuss need for rough framing an opening in ceiling or floor joists.
B. Demonstrate using plans to locate floor openings.
C. Locate and place double headers at each end of opening.
D. Locate position of double trimmer, joists on each side of opening.
E. Cut trimmers to length and install in opening with metal joist hangers.
F. Cut cripples (tail joists) to length, and lay out position fill in void joists outside of opening. Nail through inside joist plate to cripples.
G. Nail 2" leader strip on outside of header to support cripples.
H. Place double joists on outside of opening and under partition or load bearing walls.
I. Mention that all holes cut into joists for plumbing should be cut under supervision of building foreman.

II. Students frame a floor opening.

WOOD

CONTENT TITLE: Floors

SUB OBJECTIVE 8: The student will demonstrate ability to lay subflooring.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying a subfloor.

A. Demonstrate using different sheet thicknesses for subflooring.
B. Start sheets parallel to one wall with joists between sheet ends.
C. Align sheets to join at a joist; nail all joints to joists.
D. Stagger second row so that joints fall on other joists.
E. Place 1 x 12 subflooring on a 45° angle to floor joists. Cut and nail ends onto a joist.
F. When spacing 1 x 12's at 45° angle, leave a 1/4" spacing between each plank to prevent squeaking.

II. Students lay a subfloor.

WOOD

CONTENT TITLE: Floors

SUB OBJECTIVE 9: The student will demonstrate ability to place sills (sole plates) on slab foundations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates placing sill (sole plates) on slab foundations.

A. Lay a 2 x 4 against bolts and mark holes to be drilled.
B. Lay tarpaper (3 pound asphalt felt) under the 2 x 4 sill when installed.
C. Use power driven nails to anchor sill into place on inside walls; check locations.
D. Emphasize the fact that the location of each bolt should be measured; setting bolts in concrete is a difficult process.
E. Drill holes 1/8" larger than diameter of bolts to be used in sill or sole plate.
F. Place sill over anchor bolts around exterior of slab.
G. Snug anchor bolts down on sill plate with 30 pound asphalt felt paper under sill. Do not crush 2 x 4's with anchor washer and nut.
H. Lay out all partitions in house with power driven nails. Saw out openings after framing is completed.

II. Students attach sole plates to slab foundations.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to frame standard and extra deep walls (to accommodate plumbing in bathrooms), to frame openings for doors and windows and to erect them.

SOURCES OF INFORMATION

Durbahn, W. E., Fundamentals of Carpentry, 4th revised ed., (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Lux, Donald G., and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Mix, Floyd M., ed., Practical Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1963.

Standard Construction Details, (Standard Homes Co.: Colorado Building, Washington, D. C. 20002).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Plumbing and squaring walls

Science

- Dynamic pressure and stresses on load bearing walls and roofs

Communication Skills

- Related safety
  - Raising new wall sections
  - Use of ladders and scaffolds
- Student Resource Manual
- Vocabulary development

WOOD

CONTENT TITLE: Walls

SUB OBJECTIVE 10: The student will demonstrate ability to frame a window opening.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates framing a window opening.

A. Discuss reasons for which window units are hung and not set in the rough opening level and plumb.
B. Demonstrate calculating rough opening sizes, for different units in a house by using actual size of window and allowing for spacing.
C. Cut trimmers or cripple studs 6' 8-1/2" long to support headers.
D. Cut two 2 x 6 headers the width of the rough window opening plus the width of two 2 x 4's (these to be placed adjacent to the window on each side).
E. Place headers upright with a piece of 3/8" plywood between them to make total width of 2 x 4's with crown on header.
F. Place a full length stud next to each trimmer for bracing.
G. Cut and place a subsill to set the rough window height.
H. Cut and place cripples on even 16 or 24 inch units, marked earlier on sole plate and top plate.
I. Nail two small blocks to trimmers for support of subsill, or use cripples on each side of trimmer stud.

II. Students frame a window opening.

WOOD

CONTENT TITLE: Walls

SUB OBJECTIVE 11: The student will demonstrate ability to frame a door opening.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates framing a door opening.

A. Demonstrate calculating rough opening sizes for different units in the house.
B. Cut cripple studs (trimmers) 6' 8-1/2" for each side of rough opening; these support headers.
C. Cut two 2 x 4 headers (lintels), the width of the rough opening, plus the width of two 2 x 4's.
D. Place headers upright with a piece of 3/8" plywood between them to make the total width of 2 x 4's.
E. Place a full length stud next to each cripple. This stud is used for attaching trimmers and for bracing.
F. Cut and place cripples on even 16 or 24 inch units, marked earlier on top place.
G. Stud height on pocket and glass-type doors vary with the door.

II. Students frame a door opening.

WOOD

CONTENT TITLE: Walls

SUB OBJECTIVE 12: The student will demonstrate ability to frame a wall section.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates framing a wall section.

A. Mark and drill hole in sole plate for anchor bolt.
B. Place sole plate onto anchor bolts and bolt down the 2 x 4 plate.
C. Lay out "T" partition for all rooms on the sole plate and top plate using a framing square or tape.
D. Lay out all corner posts on sole plate and top plates.
E. Demonstrate using plans to obtain dimensions for rough openings on windows and doors.
F. Demonstrate laying out window and door openings on sole plates and top plates.
G. Cull 2 x 4 material for studs to remove lumber with knots and crown and badly warped material.
H. Cut stud lengths to 7' 8-5/8" for a total wall height of 8' 1".
I. Build corner boxes using three studs and three 18" pieces for inner pieces.
J. Build "T" partitions for room dividers, using three studs with three 18" inner pieces.
K. Build rough framing for door and window openings.
L. Lay out stud placement on sole plate and top plate using units of 16" or 24" and beginning at inside stud of corner box.
M. Set off continuous units of either 16" or 24" in door and window openings using these for placing cripples.
N. Mention that there must be a 2 x 4 stud running continuously every 4 feet across a wall starting at inside of corner box, with a cripple at four foot units in door and window openings.
O. Nail all door, window, "T" partitions and corner boxes to top plate while it is laying on the slab floor.
P. Raise wall sections and temporarily square them with temporary bracing.

Continued ...

WOOD

CONTENT TITLE: Walls (Continued)

SUB OBJECTIVE 12: The student will demonstrate ability to frame a wall section.

SUGGESTED ACTIVITIES: (Students and Teachers)

Q. Toe nail studs, door and window units to sole plate markings.

R. Install a 1 x 4 let-in brace on an angle by notching the studs and nailing the brace to each stud or on outside of studs if a brick ledge is used.

S. Install fire blocks (dead wood) between studs. These are short 2 x 4's positioned between framing members approximately waist height.

II. Students frame a wall section.

WOOD

CONTENT TITLE: Walls

SUB OBJECTIVE 13: The student will demonstrate ability to frame a bathroom wall for plumbing pipes.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates framing a bathroom wall for plumbing pipes.

   A. Point out need for a 2 x 6 framed wall to allow room for plumbing. Mention also that this type of wall possesses additional strength to support fixtures.
   B. Demonstrate how studs can be cut without weakening structure wall.
   C. Point out that plumber must follow restrictions regarding cutting holes and notching framing. Holes and notches should be as small as possible and should be cut under supervision of building foreman.

II. Students frame a wall for a bathroom.

WOOD

CONTENT TITLE: Walls

SUB OBJECTIVE 14: The student will demonstrate ability to plumb walls and tie them with double top plate.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates plumbing wall and laying walls with double top plate.

A. Demonstrate using plans to secure dimensions for inner wall placement.
B. Build inner walls in same manner as outer walls.
C. Position and secure sole plate with nailing gun or steel nails.
D. Use a level to plumb wall sections.
E. Plumb inner wall sections, and place temporary bracing.
F. Run second plate on top of first plate and overlap each section where no two breaks are in the same place.
G. Recheck plumb of wall sections while placing second plate.
H. Remove temporary bracing from wall section after all material is in place.
I. Make any adjustments necessary to plumb each wall section.

II. Students plumb walls and lay out walls with double top plates.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to lay out and frame ceilings and roofs. The student should be able to frame gable ends for roofs, hip and valley roof structures and all component parts for roof systems, including truss-systems of building.

SOURCES OF INFORMATION

Durbahn, W. E., Fundamentals of Carpentry, 4th revised ed., (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Lux, Donald G., and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Mix, Floyd M., ed., Practical Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1963.

Standard Construction Details, (Standard Homes Co.: Colorado Building, Washington, D. C. 20002).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Pitch - ratios and proportions
- Interpreting carpenter's square information
- Layout computations for truss building
- Review of math requirements for job entry or higher education

Communication Skills

- Related safety
  - Falls and other hazards
  - Lifting of materials
- Manufacturer's literature
- Review of communication skill requirements for job entry or higher education
- Review career options available
  - Job
  - Apprenticeship training
  - Armed services
  - Technical and professional training

WOOD

CONTENT TITLE: Ceilings and Roofs

SUB OBJECTIVE 15: The student will demonstrate ability to lay out ceiling joists.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out ceiling joists.

A. Demonstrate determining direction of ceiling joists from plans.
B. Demonstrate checking tables to determine size of ceiling joists needed for span.
C. Lay out ceiling joists on equal-spaced units of 16" or 24".
D. Position outside joist against outside edge of top plate or 2" back from outside edge if a header is to be used.
E. Position joists for load bearing partitions and locate beams for openings in ceiling.
F. Select material and cut to length. Mark "crown" on each.
G. Cut and fasten (by toe nailing) joists to double plate.
H. Cut joists to length, or splice joists over load bearing wall.
I. Cut angle or rake cut for junction of rafters on joists.

II. Students lay out a ceiling.

WOOD

CONTENT TITLE: Ceilings and Roofs

SUB OBJECTIVE 16: The student will demonstrate ability to frame a roof.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates framing a roof.

A. Demonstrate using plans to indicate roof shape, pitch and roof span.
B. Demonstrate determining rafter size, for roof span and slope.
C. Demonstrate framing different roof shapes. Illustrate layout of different types such as conventional, hip and valley and Mansard.
D. Demonstrate selecting materials and checking and marking rafter materials for location of crown.
E. Demonstrate layout for a rafter with overhang. Use a chart to determine rafter length.
F. Demonstrate positioning a 2 x 6 ridge board and securing it temporarily with braces. Demonstrate bracing all joints in roofing section.
G. Demonstrate how a rafter is nailed to plates and ridge boards by driving 16d common box nails through the ridge board into the rafter.
H. Demonstrate nailing collar beam to rafters on both sides by forcing "crown" into the rafter on each side.
I. Demonstrate why a bird's mouth is cut into a rafter and when it is left out.
J. Demonstrate how to mark and cut tail for overhang.
K. Demonstrate nailing bracing to collar beams and rafters.

II. Students frame a roof.

WOOD

CONTENT TITLE: Ceilings and Roofs

SUB OBJECTIVE 17: The student will demonstrate ability to cut a rafter.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates cutting a rafter.

A. Demonstrate using plans to determine roof pitch. Use roof pitch unit run and unit rise with horizontal span in cutting rafters.
B. Calculate lumber length to order for rafter materials.
C. Cut actual rafter length, adding overhang and tail cut and subtracting for ridge cut.
D. Demonstrate cutting bird's mouths, seat cuts and heels on building line. Then cut tail cut leaving projected distance for overhang.
E. Cut rafters to allow for ridge board and demonstrate making a plumb line cut.
F. Demonstrate positioning crowned edge of rafter up before rafter is actually laid out.
G. Cut a mate for the other side using a pattern.
H. Check the two rafters for conformance to roof pitch. Check to ensure that bird's mouth seat is level.
I. All ceiling joists, collar beams and rafters should be spaced 16" or 24" apart.
J. Demonstrate nailing rafters to ridge board, collar beam and top plate.

II. Students cut rafters.

WOOD

CONTENT TITLE: Ceilings and Roofs

SUB OBJECTIVE 18: The student will demonstrate ability to cut and place hip and valley rafters.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates cutting and placing a hip and valley rafter.

A. Demonstrate using roof pitch in cutting hip and valley rafters.
B. Demonstrate setting off center line on hip and valley rafter.
C. Demonstrate setting off length of rafter to bird's mouth, then adding overhang and tail cut to conform to rafters on either side.
D. Demonstrate placing crowned edge of rafter up before actual hip or valley rafter is laid out.
E. Demonstrate cutting hip and valley rafter using a plumb line and cutting each side into middle of rafter.
F. Demonstrate cutting the hip and valley rafter half the 45° thickness of a common rafter so that it will fit into slot between other rafters.
G. Demonstrate checking hip and valley rafters for conformance to roof pitch of other rafters.
H. Demonstrate spacing jack rafters onto hip and valley sections.
I. Demonstrate measuring and cutting the longest jack rafters first.
J. Demonstrate nailing jack rafters into place.
K. Jack rafters evenly spaced along the ridge board have a common difference in length.
L. Demonstrate cutting a camber on a hip rafter. This allows sheathing to lay flat.

II. Students cut and place hip and valley rafters.

WOOD

CONTENT TITLE: Ceilings and Roofs

SUB OBJECTIVE 19: The student will demonstrate ability to frame a gable end for a roof.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates framing a gable.

A. Place gable studs on 16" or 24" unit measurements across end of gable.
B. Demonstrate using tongue and blade of a framing square to set off measurements.
C. Demonstrate using framing square to check roof slope.
D. Demonstrate using framing square to mark angle cuts on studs to be positioned against rafters.
E. Demonstrate using framing square and gable slope to find the common difference in stud lengths.
F. Demonstrate using framing square to set and check horizontal members.

II. Students frame a gable end.

TRIMMING AND SIDING

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to prepare buildings for application of asbestos siding and to apply siding. The student will treat corners both with corner board applications and woven corner joints.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builder 3 & 2, NAVPERS 10648-F, 1970. (Order from GPO, Document No. D208.11:B86/3/970.)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material and tool sizing

Science

- Properties of asbestos

Communication Skills

- Related safety
  - Ladders and scaffolds
  - Power tool operation
  - Working with asbestos
- Student Resource Manual
- Manufacturer's literature
- Blueprint reading

WOOD

CONTENT TITLE: Preparing for Siding

SUB OBJECTIVE 1: The student will demonstrate ability to prepare a building for application of asbestos siding.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses application of asbestos siding.

A. Discuss composition of asbestos siding shingles and outline basic sizes of supplied units.

B. Discuss proper care and handling of siding prior to application.

II. Instructor demonstrates preparing building for application of asbestos siding.

A. Apply metal flashing around all door and window openings. Flashing should protect all horizontal surfaces and should carry down all water-carrying vertical surfaces to prevent moisture from creeping back under flashing by capillary action.

B. Flash all outside corners and inside corners with a 12-inch wide strip of underlay material centered in or around the corner when corner boards are used.

C. When shingles are to abutt each other at corners, carry underlayment from each wall face around the corner so that a double layer results at the corner. In addition, a backer strip (narrow tap of material) should be folded at each course of shingles at the corner.

D. Nail a 1/4" by 1-1/2" wood strip (cant strip) along bottom edge of sheathing so that it is level and overhangs the top of the foundation. Overhang should be adequate to allow sealing joint between sheathing, framing sill and foundation top.

E. If wooden boards are to be used, fabricate corner boards by attaching a 1 x 3 to a 1 x 4 to form a corner (in this way, a face surface of a nominal 3" dimension will be formed when unit is attached to corner).

Continued ...

WOOD

CONTENT TITLE: Preparing for Siding (Continued)

SUB OBJECTIVE 1: The student will demonstrate ability to prepare a building for application of asbestos siding.

SUGGESTED ACTIVITIES: (Students and Teachers)

F. Determine total number of courses to complete one wall and lay out the job so that top courses under eaves will not be too narrow or wedge-shaped, by making small adjustments in spacing as necessary.

G. Remove all unnecessary projections from wall.

H. Snap a level chalk line all round the building to fix the location of top edge of first course. Provide for a 1/4" overhang (over bottom edge of cant strip) to provide for a drip edge.

I. Snap all additionally required chalk lines, providing for specified overhand (or exposure) of shingles.

III. Students prepare a building for application of asbestos siding.

WOOD

CONTENT TITLE: Installing Siding

SUB OBJECTIVE 2: The student will demonstrate ability to apply asbestos siding to a building previously prepared.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying asbestos siding.

A. Start at outside corner of building with a full shingle unit. Set left edge plumb and level and drive first nail. (Use nails supplied with siding to ensure correct color match.)

B. Before attaching right side of shingle, insert backer and strip with final nail. Double check position of first shingle unit as this unit determines the rest of the course.

C. Continue applying shingles as before, remembering to install backer strip of underlay material under each vertical joint.

D. As end of first course approached, measure remaining space and determine width of last unit required. If a unit space less than 6" is indicated, trim prior shingles to allow for a more even shingle size. This will require punching new nail holes in the trimmed shingles.

E. Work up to corner, or edge, and bed in compound, taking care not to spoil face of shingle with compound, or allow any exposed compound to spoil appearance of joint. All units should be tightly butted; wedge shaped joints are indicative of poor workmanship.

F. Start second course. Remember that vertical joints should fall on halves or thirds. Break a unit, or use one of the supplied smaller units to start the joints falling in this manner.

G. Insert a nail into nail hole and set its shank against top edge of next lower course. Top of shingle should be aligned with chalk line. Plumb and level shingel, check alignment with remaining nail hole, insert underlayment backer strip and finish attaching shingle.

H. Continue course as before, trimming as necessary to avoid very short final units. Bed final units as before, in compound.

Continued ...

WOOD

CONTENT TITLE: Installing Siding (Continued)

SUB OBJECTIVE 2: The student will demonstrate ability to apply asbestos siding to a building previously prepared.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. If lapped adjoining courses are used at outside corners, temporarily place a whole shingle against each adjoining wall so that they meet and join at the corner. Scribe and cut adjoining vertical edges to that they meet and join at the corner. Corner joints should be lapped left and right in alternating courses; courses on adjoining walls should meet and match at corners.

II. Students apply asbestos siding.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to frame prefabricated doors and windows.

SOURCES OF INFORMATION

Durbahn, W. E., Fundamentals of Carpentry, 4th revised ed., (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Wagner, Willis, Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Degrees and angles

Communication Skills

- Manufacturer's literature
- Vocabulary development
- Student Resource Manual
- Related safety
  - Falls and other hazards

WOOD

CONTENT TITLE: Doors and Windows

SUB OBJECTIVE 3: The student will demonstrate ability to frame a prefabricated casement window.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing trim on a casement window.

A. Mark and saw offset in stool for depth of rabbet.
B. Sand all sawed edges before installing stool. When nailing trim, either drill pilot holes or lubricate nails with soap or wax to prevent spliting case.
C. Mark and saw apron. If apron piece is molded, saw contour on both ends with coping saw. Allow for total width of window, including both casings.
D. Install stool and apron.
E. Scribe a 3/16" margin along edge of both head jamb and side jamb. These will be guidelines for side and top casings.
F. Saw one end of casing material square, against stool on sides of window. Repeat for other side casing.
G. Locate short point of miter for intersection of side and head casings and mark.
H. Remove casing and cut miter joint.
I. Mark and cut miter joint on each side of head casing piece to match miter on side casing piece.
J. Clean burrs from miter joints with a plane or sandpaper before installing.
K. Align casing pieces with scribed line on jambs.
L. Nail side casing using 6d finishing nails spaced 12" to 14" apart. Tack casing at this time.
M. Nail head casing into place between side jambs and side casing.
N. Nail outside edge of casing into cripple studs. When fit is assured, nail (final) all casing material to jambs.
O. Countersink all nails to a depth of 1/16". Putty nail holes.

II. Students install a trim on a casement window.

WOOD

CONTENT TITLE: Doors and Windows

SUB OBJECTIVE 4: The student will demonstrate ability to frame a prefabricated door.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing trim on a door.

A. Scribe a margin 5/16" from edge of both head and jamb on both sides of door for casing trim.
B. Mark and cut square joint to fit against floor.
C. Locate, mark and cut miter joint at top of each jamb casing (allow for margin).
D. Locate, mark and cut miter joint at top of each side of head casing to match miter on jamb casing.
E. Sand all sawed edges.
F. Set casing at scribed line on jamb and head.
G. Double check fit and alignment. When fit is assured, nail final outside edge of casing to cripple studs with 8d nails.
H. Nail side casing to jambs and head first, using 4 or 6d finishing nails spaced 12" to 14" apart, only tacking at this time.
I. Countersink all nails to a depth of 1/6". Putty nail holes and intersections.

II. Students trim a door.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to level, fit, install and trim out prefabricated cabinetry.

SOURCES OF INFORMATION

Durbahn, W. E., Fundamentals of Carpentry, 4th revised ed., (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Wagner, Willis, Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Level, plumb and squaring
- Scale measurement

Communication Skills

- Manufacturer's literature concerning prefabricated and module units
- Working drawings and symbols
- Catalog usage and ordering units

WOOD

CONTENT TITLE: Cabinets

SUB OBJECTIVE 5: The student will demonstrate ability to install prefabricated cabinet.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fitting prefabricated cabinets.

A. Position cabinet in place.
B. Level top in each direction by wedging cabinet.
C. Set a pair of scribers for maximum distance between floor and cabinet. Scribe a line on cabinet sides parallel to floor.
D. Trim cabinet on side and saw (for wide cuts) or plane material to scribe line.
E. Reposition cabinet and double check leveling. Make final adjustments.
F. Push cabinet tightly against wall. Set scribers as before for maximum distance between wall and cabinet. Scribe a line parallel to wall along all abutting sides of cabinet.
G. Turn cabinet over a trim along line with saw or plane. Undercut slightly to ensure a tight fit.
H. Reposition cabinet and check edges for fit. Adjust as necessary.
I. Toe nail top and sides of cabinet into wall studs and floor, respectively, and check alignment. Make corrections as necessary and final installation.
J. Hang ceiling-mounted cabinets by screwing upper mounting pieces to mounting soffitts. Adjust cabinet for best possible fit--do not try for a perfect fit.
K. Apply trim around joints between cabinets and soffitts, walls, etc. to conceal ill-fitting work.

II. Students position prefabricated cabinets.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to install pre-finished panelling.

SOURCES OF INFORMATION

Brann, Donald R., How to Apply Panelling, (Easi-Bild Pattern Co., Inc.: Box 215, Briarcliff Manor, New York, New York 10510), 1970.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Estimating materials
- Material sizing and grades

Science

- Adhesives
- Identification of various hardwood and synthetic finishes

Communication Skills

- Catalog work
- Related safety
  - Working with power equipment and tools
- Vocabulary development
- Technical literature
- Student Resource Manual

WOOD

CONTENT TITLE: Panelling

SUB OBJECTIVE 6: The student will demonstrate ability to install pre-finished panelling.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing pre-finished panelling.

A. Discuss proper storing, handling and acclimating techniques.
B. Plan room layout. Start from plumb corners and work toward openings. This minimizes number of cuts to be made.
C. Check stud layout for modular spacing. Install studs or furring strips where necessary.
D. Cut panel pieces to make up for out-of-plumb rooms. Use dividers to copy room errors onto panelling and cut panels to fit.
E. Measure, locate and cut openings in sheets for wall plugs, windows, etc.
F. Demonstrate applying panels to studs using concealed nail adhesive and nail-and-adhesive methods.
G. Work panelling up to corners. Install corner molding and continue.
H. When hanging with accoustical ceiling, leave 1/4" gap at bottom of sheet. Cover later with molding.
I. Install cove molding, baseboards and shoes. Trim out windows and doors.

II. Students install panelling.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to lay out, fabricate and install baseboard trim, shoe trim and cove molding.

SOURCES OF INFORMATION

Durbahn, W. E., Fundamentals of Carpentry, 4th revised ed., (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Bureau of Naval Personnel, Builder 3 & 2, NAVPERS 10648-F, 1970. (Order from GPO, Document No. D208.11:B86/3/970.)

Wagner, Willis, Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review math requirements for job entry and higher education

Communication Skills

- Student Resource Manual
- Vocabulary development
- Review communication skills requirements for job entry and higher education
  - Apprenticeship program
  - Direct job placement
  - Armed services
  - Junior and senior college, technical and professional areas

WOOD

CONTENT TITLE: Trim

SUB OBJECTIVE 7: The student will demonstrate ability to lay out and install baseboard and shoe trim.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses baseboards and shoe molding and demonstrates the basic cuts required to fit this material.

A. Discuss different types, styles and shapes of molding and their typical applications.

B. Outline basic purposes of molding, such as concealment and decoration.

C. Demonstrate making miter cuts. Emphasize that in trim work, all miter measurements must be made from the inside of the molding material; appropriate corrections must be made, therefore, to ensure a proper fit.

D. Demonstrate cutting a coping joint. To do this:

1. Saw off end of abutting member (member we wish to shape to the outline of another piece) square.
2. Miter-cut end to 45° (short length should be face of molding), thus cutting off a small segment of material.
3. Set coping blade at top of line of miter cut, perpendicular to lengthwise axis of piece.
4. Cut off a segment, following closely face line left by miter cut. The end of the abutting member will now match the face of the other member.

II. Instructor demonstrates installing baseboards and shoe molding.

A. Mark location of studs prior to installation of trim; this ensures that trim will be attached to studs rather than wallboard, etc.

B. Select base material so as to avoid, if at all possible, mid-run splices.

C. Set "inside corner" walls first. Cut piece 1/8" longer than wall space (or twice miter saw kerf width) with a square butt joint to abutt door casings or inside corners.

Continued ...

WOOD

CONTENT TITLE: Trim (Continued)

SUB OBJECTIVE 7: The student will demonstrate ability to lay out and install baseboard and shoe trim.

SUGGESTED ACTIVITIES: (Students and Teachers)

D. Measure and cut coping joint (for inside corners) and miter cuts for outside corners (loss on coping cut is approximately equal to depth of molding) or cut coping joints and then measure and cut miter cuts.
E. Check intersection, prior to nailing, of boards on all joints to ensure tight fit and proper lengths to fit walls.
F. Tack into position.
G. When splicing is necessary, cut end of material at a 45° angle, such that cut will fall over a stud. Cut next piece on a reverse 45° angle and continue.
H. Position baseboard and nail into place.
I. Likewise, prepare shoe molding, (NOTE: all joints are mitered on shoe molding), and tack into place, attaching to floor--not to baseboard.
J. Countersink all nails and fill nail holes with putty.

III. Students install baseboard and shoe molding.

WOOD

CONTENT TITLE: Trim

SUB OBJECTIVE 8: The student will demonstrate ability to lay out and install cove moldings.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses cove moldings and their typical applications.

A. Discuss different types, styles and shapes of molding and their typical applications.
B. Outline basic purposes of cove molding; mention material's popularity in applications involving concealing juncture between panelling and ceilings, or other dissimilar wall and ceiling treatments.
C. Review students on processes of measuring and making miter and coping cuts.

II. Instructor demonstrates installing cove molding.

A. Mark location of joists prior to installation of trim; coving is attached to ceiling joists so that if building settles, coving will conceal any cracks which may appear.
B. Select material so as to avoid, if at all possible, mid-run splices.
C. Set "inside corner" walls first. Cut piece 1/8" longer than wall space (or twice miter saw kerf width) with a square butt joint to abutt door casings or inside corners.
D. Measure and cut coping joint (for inside corners) and miter cuts for outside corners (loss on coping cuts is approximately equal to depth of molding) or cut coping joints and then measure and cut miter cuts.
E. Check intersection prior to nailing of boards on all joints to ensure tight fit and proper lengths to fit walls.
F. Tack into position.
G. When splicing is necessary, cut end of material at a 45° angle, such that cut will fall over a joist. Cut next piece on a reverse 45° angle and continue.
H. Countersink all nails and fill nail holes with putty.

III. Students install baseboard and shoe molding.

FLOORING

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to inspect and prepare a concrete slab for application of hardwood strip flooring. In addition, student will likewise install hardwood strip flooring, demonstrating ability to correct for defects in the room construction while working.

SOURCES OF INFORMATION

Installation Manual, (Armstrong Cork Co.: Lancaster, Pennsylvania), 1969.

Schmidt, Bennet and Lewis, Construction: Principles, Materials and Methods, (United States Savings and Loan League with the American Savings and Loan Institute Press, Architectural and Construction Research Department: 111 East Wacker Drive, Chicago, Illinois 60601), 1972.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material and tool sizing
- Level, plumb and square

Science

Moisture barriers

Concrete surface contamination

Communication Skills

- Student Resource Manual
- Manufacturer's literature
- Blueprint reading and symbols
- Related safety
  - Working with mastic and other toxic materials

WOOD

CONTENT TITLE: Preparation

SUB OBJECTIVE 1: The student will demonstrate ability to test a concrete floor for moisture.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates testing a concrete floor for moisture.

A. Position relative humidity indicator on floor next to wall or pillar.
B. Cover indicator with square of polyethylene, 18" square or larger and fasten to floor with friction tape.
C. If slab is 4" thick, or less, run test for 24 hours; if slab thickness exceeds 4", run test at least 72 hours.
D. Indicator temperature should be held as nearly corstant as possible and should therefore be insulated with sheets of burlap, fiberglass or other insulator.
E. If indicator shows a relative humidity of 80% or more, slab is too damp--flooring should not be applied until later.

II. Students inspect a concrete slab for moisture.

WOOD

CONTENT TITLE: Preparation

SUB OBJECTIVE 2: The student will demonstrate ability to prepare a concrete subfloor for application of hardwood flooring.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing a concrete subfloor.

A. If any paint, varnish, oil, etc. has not been removed, it should be before further preparations are undertaken.
B. Clean out all cracks and expansion joints.
C. Dusty or chalky concrete should be swept clean and one coat of sizing applied.
D. Fill cracks, expansion joints, etc. with manufacturer's recommended latex filler or other floor patch compound. Compound is usually applied with a putty knife.

II. Students prepare a concrete subfloor for application of hardwood flooring.

WOOD

CONTENT TITLE: Preparation

SUB OBJECTIVE 3: The student will demonstrate ability to apply screeds or furring in asphalt prior to application of hardwood flooring.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying screeds in asphalt prior to application of flooring.

   A. Discuss various methods which may be used to apply furring to subfloors. Mention that method will depend largely on plan specifications.
   B. Discuss application of 2 x 4 sleepers (short pieces staggered in rows).
   C. Demonstrate spreading hot and cold asphalt mastics over slab surfaces by mopping, rolling, trowelling and squeegeeing.
   D. Embed 1 x 2 sleepers in hot mastic and secure with concrete nails.
   E. Spread polyethylene over floor, pulling sufficiently taut to prevent film from touching slab.
   F. Attach a second course of sleepers over first, offsetting joints.

II. Students lay screeds in asphalt prior to application of flooring.

WOOD

CONTENT TITLE: Preparation

SUB OBJECTIVE 4: The student will demonstrate ability to level screeds of furring prior to application of hardwood flooring.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing screeds and furring for application of flooring.

   A. Ensure that all furring straps are level. Use a carpenter's level to check this.
   B. Demonstrate using a straightedge to detect small, high or low spots in furring.
   C. Demonstrate use of taut strings, stretched tangent to mounting surface, to detect large flaws.
   D. Plane down or otherwise level any high spots; fill low spots as necessary.
   E. Sweep or scrape clean all remaining debris. Do not use water to clean.

II. Students prepare screeds and furring for application of flooring.

WOOD

CONTENT TITLE: Installation

SUB OBJECTIVE 5: Given a square room to work in, the student will demonstrate ability to correctly install hardwood strip flooring.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing strip flooring.

A. Locate all electrical conduit, pipes and other obstructions. Provide protection as necessary.

B. Illustrate that flooring should be applied parallel to long direction of largest room (usually living room). This, in turn, determines direction of application for entire house.

C. Face nail first strip course on edge of flooring next to wall. Leave a gap about 1/2". Do not allow gap to exceed dimension which will be covered by baseboard and shoe molding.

D. Blind nail the following courses on the tongue edge. Countersink nail with center punch. Alternately, demonstrate application using floor nailing machines and power equipment.

E. Every second or third course, draw flooring up by pushing a scrap piece of flooring over tongue of installed flooring and hammering strips back towards the completed work until they fit snugly. Take care while performing this operation, and check trueness of square occasionally to ensure that it is not being disturbed by the drawing up process. Correct as you work.

F. Use long pieces in front of doorways; do not allow joints in flooring to occur in front of doorways.

II. Students lay hardwood strip flooring.

WOOD

CONTENT TITLE: Preparation

SUB OBJECTIVE 6: The student will demonstrate ability to determine a room's squareness, and to correct for error in the process of laying flooring material.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates inspecting a room for squareness.

A. Measure room across both diagonals. If diagonal measurements are equal, room is square.
B. If room is not square, strike off a square portion. This may be done by running a line alongside a carpenter's square.
C. In very large rooms, it may be necessary to construct the square line for the room. To do this, first determine the short end of the room. Then, strike off this measurement on the long end. Strike a line between starting corner and struck-off point. This is the first true line. Snap other true lines parallel as required.

II. Instructor demonstrates correcting for an untrue room while laying flooring.

A. Strike off a true line after starting courses.
B. Use a carpenter's plane, or better, special tool, and plane down flooring strips. Plane each strip on narrow end of room down slightly and continue process until strips are running parallel to true line.
C. If error is slight, floor may be drawn up more snugly at one end than at the other. A surprising amount of correction may be made in this way, and the correction is almost invisible even to trained eyes.

III. Students correct for an untrue room while laying flooring.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to install hardwood strip flooring over subfloors and over old wood floors.

SOURCES OF INFORMATION

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Computing square feet
- Estimation of material

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Vocabulary development
- Related safety
  - Repair and preparation of old wooden surfaces

WOOD

CONTENT TITLE: Preparation

SUB OBJECTIVE 7: The student will demonstrate ability to inspect and prepare a wooden floor, preparatory to installing flooring.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparation of wooden floors for application of hardwood flooring.

   A. Ensure that floor has a sufficient clearance underneath to prevent accumulation of moisture. Flooring should not be laid over poorly ventilated floors.
   B. Remove any old paint, varnish, wax, dirt, etc. from old floor by sanding.
   C. Nail down loose boards. Remove and replace defective units.
   D. Fill and smooth cracks, holes and/or other surface irregularities. Use plastic wood for this.
   E. Plane or sand down any high spots. Rip cut any excessively warped boards and renail.

II. Students prepare wooden floors for application of hardwood flooring.

WOOD

CONTENT TITLE: Application

SUB OBJECTIVE 8: The student will demonstrate ability to apply strip flooring over wood subfloors and old flooring.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying strip flooring over wood subfloors and over old flooring.

   A. Drive down all protruding nail heads. Nail down loose and warped boards and flooring.
   B. Plane or nail down high and uneven subflooring.
   C. Remove base shoe, molding and threshold strips from old floors.
   D. Apply building paper over subfloor or over old flooring.
   E. Apply strip flooring at right angles or 45° angles to boards of subflooring and blind nail into position.
   F. If applying over old flooring, apply at right angles to old flooring and blind nail into position.
   G. If applying flooring to floor joists, all joints should occur directly over joists. Otherwise, they will fail.

II. Students apply strip flooring over wood subfloors and over old flooring.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to lay out and install hardwood laminated wood block (Parquet) flooring in straight and alternating patterns and on diagonals.

SOURCES OF INFORMATION

Installation Manual, (Armstrong Cork Co.: Lancaster, Pennsylvania), 1969.

Schmidt, Bennet and Lewis, Construction: Principles, Materials and Methods, (United States Savings and Loan League of American Savings and Loan Institute Press, Architectural and Construction Research Department: 111 East Wacker Drive, Chicago, Illinois 60601), 1972.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Degrees and angles

Science

- Uses of various hardwoods in flooring

Communication Skills

- Manufacturer's literature
- Catalog work
- Student Resource Manual

WOOD

CONTENT TITLE: Laminated Wood Blocks

SUB OBJECTIVE 9: The student will demonstrate ability to lay out blocks preparatory to installation in a room.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out blocks.

A. Measure perimeter of floor surface with tape measure.
B. Square off room.
C. Snap chalk lines around squared-off area.
D. Measure off half length and width of squared-off area.
E. Snap chalk lines from half points of one width to half points of other width. Repeat for half points of room length.
F. Beginning at center, lay out rows of blocks along center-lines, moving in each direction.
G. If less than one full block is required to complete rows in either direction, adjust centers so that end pieces of equal width may be laid.
H. Mark new room "center" if changed.

II. Students lay out blocks.

WOOD

CONTENT TITLE: Application

SUB OBJECTIVE 10: The student will demonstrate ability to apply laminated wood blocks in plain and alternating designs.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates spreading adhesive.

A. Spread adhesive over half of room area, leaving open spaces to allow for placement of tools and to permit viewing of chalklines.
B. Strike new chalk lines over old.
C. Fill in any voids.
D. When blocks have been laid in one half of room, repeat for other side.

II. Instructor demonstrates laying blocks.

A. Position first block squarely in place, centered on intersection of chalk lines.
B. Position following blocks next to previously laid ones or with tongues in grooves. Positioning should be accurate.
C. Lay blocks out in two courses, interesecting at center of room to form a +. Trim blocks as required to fit against walls.
D. Demonstrate laying blocks in alternating directions. This is usually done in a back and forth diagonal motion, each succeeding block being laid such that its corner touches the corner of the one previously laid.

II. Students install laminated wood blocks.

WOOD

CONTENT TITLE: Cutting Laminated Wood Blocks

SUB OBJECTIVE 11: The student will demonstrate ability to cut straight and diagonal cuts on blocks.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out straight and diagonal cuts on blocks.

A. Run course up to point where less than one full block will be required to reach wall.
B. Turn block upside down, pattern parallel to under-block and rotate 90° (for standard alternating grain patterns).
C. Lay block on floor and butt against wall.
D. Using last-laid block as a marking guide, mark upside down. Use a sabre-saw or other fine toothed saw to cut block. Discard piece which was adjacent to wall.
E. Remaining half will now, when inverted, be cut to size required to fit.
F. Diagonals are cut similarly except:
1) When block has been inverted, rotate so that one edge abutts wall, (45°).
2) Slide block down so that adjacent edge touches nearest corner (to wall) of last laid block.
3) Cut and discard as before.

II. Students lay out straight and diagonal cuts on blocks.

WOOD

CONTENT TITLE: Block Application

SUB OBJECTIVE 12: The student will demonstrate ability to apply blocks to a diagonal.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and setting blocks to a diagonal.

A. Square room and snap chalk lines as for standard installation.

B. From center point O, take any convenient radius and snap points W, X, Y and Z on center lines.

C. Strike diagonals at a 45° angle to center lines. To do this, take any radius greater than OX or OY and make intersecting arcs at point A. Using the same radius and points YZ, ZW and WX, strike points D, B and C as before. Strike diagonal chalk lines AB and CD.

D. Using lines AB and CD as centerlines for room, lay out blocks. Adjust center point, and install blocks as in any regular installation.

II. Students lay out and set blocks to a diagonal.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to sand, seal, stain and wax hardwood flooring.

SOURCES OF INFORMATION

None

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review math requirements for job entry and/ or higher education

Communication Skills

- Related safety
  - Using power sanding and other other equipment
  - Working stains and sealers
- Manufacturer's literature
- Student Resource Manual
- Review communication skill requirements for job entry and/or higher education
- Review job and career opportunities available
  - Apprenticeship
  - Job
  - Higher education

WOOD

CONTENT TITLE: Finishing

SUB OBJECTIVE 13: The student will demonstrate ability to operate various sanding machines, and to select appropriate finishing materials to finish a hardwood floor.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates sanding hardwood floors.

A. Discuss safety precautions to be observed when operating power sanding equipment.
B. Discuss types and applications of sandpapers and steel wools.
C. Demonstrate difficulties inherent in operating sanders across the grain.
D. Discuss criteria for selecting final finish grades of paper and wool.

II. Students sand and finish a hardwood floor.

WOOD

CONTENT TITLE: Finishing

SUB OBJECTIVE 14: The student will demonstrate ability to apply final sealers, finishes and waxes.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates types and application of finishing sealers, stains, wood fillers and waxes.

   A. Emphasize the importance of following manufacturer's recommendations for applying most compounds.
   B. Stress urgency of starting finish work immediately after sanding. Show just how vulnerable a raw, unprotected floor is without sealers.
   C. Apply sealant and wood fillers if sanding dust has been removed. Following manufacturer's recommendations, demonstrate different methods of applying compounds to floors.
   D. If stains are required, apply them now.
   E. Allow sealer to dry. Follow manufacturer's recommendations for drying time.
   F. Apply wax. Again, application depends on type and formulation of wax. Follow recommendations.
   G. After wax has set to dry, buff to finish. Sometimes, an additional coat will be applied at this point.

II. Students seal and wax a floor.

ROOFING

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to fabricate scaffolding, to erect manufactured scaffolding and to erect wall and roofing brackets.

SOURCES OF INFORMATION

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals

Communication Skills

- Student Resource Manual
- Manufacturer's literature
- Related safety
  - Erecting and working with scaffolding, wall and roofing brackets

WOOD

CONTENT TITLE: Scaffolding

SUB OBJECTIVE 1: The student will demonstrate ability to build a wooden scaffold.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates constructing wooden scaffolding.

A. Use 2 x 4's for uprights. Such units should not exceed 18' in height.
B. Position lower ends on blocks to prevent scaffolding from settling. Fasten uprights to blocks with 3d or 4d nails.
C. Place cross-ledges every 3 or 4 feet, fastening with 10d nails, or larger.
D. Position 1 x 6 braces diagonally between cross-ledgers and fasten them to uprights with 10d nails. Where crossings occur, 8d nails should be adequate.
E. Lay out 2 x 10 planks between cross-ledgers for footings. These need not be attached to framework.

II. Students construct wooden scaffolding.

WOOD

CONTENT TITLE: Scaffolding

SUB OBJECTIVE 2: The student will demonstrate ability to erect manufactured scaffolding.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates erecting manufactured scaffolding.

A. Discuss types and styles of manufactured scaffolding.
B. Demonstrate bracing scaffolding to walls both before, during and after laying of brick, siding, etc.
C. Demonstrate leveling and plumbing scaffolding.
D. Demonstrate cutting and laying 2 x 10 planks for crosswalks.
E. Discuss and demonstrate safety considerations when extending scaffolding during construction.
F. As work progresses upwards, secure with wall brackets. Attach brackets to wall with four 16d or 20d nails. Check nail heads to ensure that they are undamaged. This is important as nail heads support most of the bracket load.

II. Students erect and extend manufactured scaffolding.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to prepare a roof for shingling.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builder 3 & 2, NAVPERS 10648-F, 1970. (Order from GPO, Document No. D208.11:B86/3/970.)

Schmidt, Bennett and Lewis, Construction: Principles, Materials and Methods, (United States Savings and Loan League with the American Savings and Loan Institute Press, Architectural and Construction Research Department: 111 East Wacker Drive, Chicago, Illinois 60601), 1972.

Strahan, J. L., Manufacture, Selection and Application of Asphalt Roofing and Siding Products, revised ed., (Asphalt Roofing Manufacturer's Association: 757 Third Avenue, New York, New York 10017), 1970.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Computing square feet
- Material weights and grades
- Roof pitches (ratios and proportions)

Science

- Weatherproofing a roof
  - Underlayment
  - Drip edges and flashing
  - Finished roofing materials

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Related safety
  - Falls
  - Carrying and stacking

WOOD

CONTENT TITLE: Roof Preparation

SUB OBJECTIVE 3: The student will demonstrate ability to inspect and prepare the roof deck.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor outlines points to look for when inspecting a roof and demonstrates preparing the deck for roofing.

   A. Mention that all decking material must be absolutely dry and smooth. Point out that protrusions may be sanded, planed, etc. prior to application of roofing.
   B. Discuss inspecting for completion of nailing schedule. Demonstrate completing any omissions and inspecting to ensure that no nailheads protrude. Drive home any protruding nailheads.
   C. Demonstrate repairing knotholes and cracks with strips of sheet metal.
   D. Sweep deck clear of chips and other stray material.

II. Students inspect a roof and prepare the deck for roofing.

WOOD

CONTENT TITLE: Roof Preparation

SUB OBJECTIVE 4: The student will demonstrate ability to apply felt underlayment material to a roof deck.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying roofing felt to a deck.

A. Estimate amount of material needed and load deck.
B. Roll out first strip of felt along edge of eave, parallel to eave, and nail down.
C. Demonstrate application with adhesives, and nailing material as it is rolled out for high wind areas.
D. Roll out and attach successive strips, overlapping previously laid strips as required (usually 4").
E. Roll out and apply top strips, overlapping roof ridge by at least 2" on each side. Demonstrate nail-and-adhesive systems of application for high wind areas.
F. Attach drip edge and other metal accessories to eaves and rake of roof. Demonstrate extending material back from edges and bending. Demonstrate application (where required) of adhesives or sealants between pieces of sheet metal applied.

II. Students apply felt underlayment material to a roof deck.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to install asphalt shingles to solid wooden sheathing.

SOURCES OF INFORMATION

Bureau of Naval Personnel, Builder 3 & 2, NAVPERS 10648-F, 1970. (Order from GPO, Document No. D208.11:B86/3/970.)

Schmidt, Bennett and Lewis, Construction: Principles, Materials and Methods, (United States Savings and Loan League with the American Savings and Loan Institute Press, Architectural and Construction Research Department: 111 East Wacker Drive, Chicago, Illinois 60601), 1972.

Strahan, J. L. Manufacture, Selection and Application of Asphalt Roofing and Siding Products, revised ed., (Asphalt Roofing Manufacturer's Association: 757 Third Avenue, New York, New York 10017), 1970.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Manufacturer's literature
- Vocabulary development
- Student Resource Manual

WOOD

CONTENT TITLE: Asphalt Shingles (Flashing)

SUB OBJECTIVE 5: The student will demonstrate ability to apply flashing materials to valleys using asphalt roll roofing material.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates flashing valleys.

A. Begin flashing at eaves and move towards ridge of roof.
B. Center a narrow strip of material, mineral surface down along valley. Fasten with nails to decking, pressing material into valley as you work.
C. Continue upwards, overlapping strips by at least 12" where necessary, and gluing with asphalt cement. Material should overlap ridge of roof.
D. Center a second, wider (usually twice as wide, or 18") strip along the valley, mineral surface up. Attach this strip to the first strip with a wide band of asphalt cement (usually 3" or more), and to the deck by nailing or nail-and-adhesive method.
E. Continue upwards, overlapping strips as before.

II. Students flash valleys.

WOOD

CONTENT TITLE: Asphalt Shingles (Flashing)

SUB OBJECTIVE 6: The student will demonstrate ability to flash ridges using mineral surfaced asphalt roll roofing.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates flashing ridging with mineral surfaced asphalt roll roofing.

   A. Center a narrow strip of material along ridge, allowing a short (1/4" to 3/8") overhang over eave.
   B. Attach to roof on either side of ridge using adhesive or nail-and-adhesive method.
   C. If overlapping is necessary, allow at least 12" overlap. Cement overlapped material with asphalt cement.

II. Students flash ridges with mineral surfaced asphalt roll roofing.

WOOD

CONTENT TITLE: Asphalt Shingles (Flashing)

SUB OBJECTIVE 7: The student will demonstrate ability to flash chimneys and abuttments of walls and roofs.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates flashing vertically-abutted surfaces.

A. Discuss different methods of flashing chimneys (base flashing and step flashing) and vertical surfaces (usually step flashing).

B. Mention that choice of flashing may be determined by condition of chimney; i.e., if mason installs metal flashing while bringing up chimney, flashing will not only be simpler, but more water-tight.

C. Demonstrate cutting asphalt material to patterns "A", "B", "C" and "D." (Base flashing method).

D. Emphasize that flashing is started after a course of shingles reaches bottom of chimney. This is because bottom chimney flashing must extend over (to carry water over) bottom course of shingles.

E. Apply front, then side and finally back pieces liberally gluing with asphalt cement.

II. Students flash a chimney.

WOOD

CONTENT TITLE: Asphalt Shingles (Flashing)

SUB OBJECTIVE 8: The student will demonstrate ability to flash a vent stack.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates flashing a vent stack using metal flashing.

A. Carry shingle courses up to point of projection of vent stack. Fit abutting shingle carefully around stack.
B. Slip flashing sleeve over stack, mold base to slope of roof and fold top into stack.
C. Continue application of shingles, fitting around flashing as before.

II. Instructor demonstrates flashing a vent stack using asphalt shingle products.

A. Carry shingle courses up to point of projection of vent stack. Fit abutting shingle carefully around stack.
B. Cut an oval in the flashing material (55 lb. or heavier asphalt felt) in such a way as to allow at least a 4" extension below stack, 6" on each side and 8" above.
C. Press flashing down over pipe.
D. Carefully apply a "collar" of asphalt cement around stack, extending cement up and around stack by at least 2". Work cement well to assure good adhesion and freedom from air pockets.
E. Continue laying courses of shingles up roof, fitting abutting shingles as before and carefully and firmly embedding shingles in asphalt cement collar.

III. Students flash a vent stack using metal and asphalt flashing.

WOOD

CONTENT TITLE: Asphalt Shingles

SUB OBJECTIVE 9: Given a prepared roof surface, the student will demonstrate ability to apply asphalt shingles following standard commercial practice.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying asphalt shingles.

A. Discuss criteria for selecting starting points.
B. Snap chalk lines parallel to the eaves and ridge for every second or third course of shingles to be laid.
C. Lay a course of shingles, upside down, along eave. (This prevents tab notches in shingles from being visible on bottom course.) Nail in upper corners.
D. Lay another layer directly over first course, right-side up. Nail above and to right of tab notches. Nail carefully--do not break surface integrity.
E. Cut half a tab on outside of a shingle off with knife or shears, (usually 6"). This is the first shingle of the second course.
F. Start second course by laying prepared shingle above course below, fastening so that bottom edge of shingle lies just above top of tab notches in shingle below. Strictly speaking, shingles should be nailed, two nails to a tab, all nails positioned about 6' 1/2" from butt edge to ensure that penetration occurs through two shingles. Nail heads should be covered by succeeding courses. One nail to a tab is common practice.
G. Continue courses upward, alternating positions of tab notches.

II. Students apply asphalt shingles to a roof.

WOOD

CONTENT TITLE: Asphalt Shingles

SUB OBJECTIVE 10: The student will demonstrate ability to develop a pattern for cutting shingles to fit ridges and valleys.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates developing a pattern.

NOTE: There are a variety of ways used by roofers to develop patterns. The instructor may wish to substitute his own favorite, in place of the following.

A. Determine unit length of a common rafter.
B. Determine unit run of a common rafter.
C. Set a framing square, backside-up, on a strip of shingle or a 1 x 6. Set unit run on tongue and unit length on blade.
D. Scribe a line along the tongue and cut along this line. The angle so cut will fit ridges and valleys of equal pitch hip and valley roofs.

II. Students develop a pattern for cutting shingles to fit ridges and valleys.

WOOD

CONTENT TITLE: Asphalt Shingles

SUB OBJECTIVE 11: The student will demonstrate ability to shingle hips, ridges and valleys using weave patterns.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates shingling hips and ridges.

A. Either procure special hip and ridge shingles from manufacturer or fabricate them by cutting square ridge shingles from regular strips.
B. Bend shingles lengthwise along ridge centerline.
C. Beginning at bottom of hips or at one edge of ridge, overlap shingles such that only about 5" of each shingle is exposed. Attach with roofing nails and cement lower edge of shingles to previously laid course with asphalt cement.
D. Apply woven valley shingles by first stopping course development about 3' from valley. (Alternately, courses may be woven into valley, one course at a time, both courses being carried up to the valley simultaneously.)
E. Lay first course over valley lining from one surface and up the next (usually for at least 12").
F. Lay first course from other roof surface over valley lining and up adjoining (previous) surface (usually at least 12").
G. Continue laying courses, alternately weaving one over the other. Press all shingles tightly into valley, but do not nail too close to valley centerline. Use asphalt cement along centerline if desired.

II. Students shingle hips, ridges and valleys using weave patterns.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to install asphalt roll roofing.

SOURCES OF INFORMATION

Strahan, J. L., Manufacture, Selection and Application of Asphalt Roofing and Siding Products, revised ed., (Asphalt Roofing Manufacturer's Association: 757 Third Avenue, New York New York 10017), 1970.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Manufacturer's literature
- Vocabulary development
- Student Resource Manual

WOOD

CONTENT TITLE: Roll Roofing

SUB OBJECTIVE 12: The student will demonstrate ability to apply roll roofing using the exposed nail method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying roll roofing using the exposed nail method.

   A. Prepare deck and free of all obstructions, debris, etc. Apply felt.
   B. Flash ridges, valleys and eaves.
   C. Cut roofing material into 12-18' lengths. Spread out until flat.
   D. Beginning at bottom of roof, lay out first sheet parallel to eave of roof, overhanging eave by 1/4" to 3/8".
   E. Fasten with roofing nails placed along upper and lower edges of material.
   F. Lay out succeeding courses as was the first, fastening an overlay (usually about 6") with asphalt cement.
   G. Continue up to roof ridge. There apply at least one additional layer, preferably using nail-and-adhesive method. Single layer ridges wear rapidly as birds tend to pick material coating off of base material with their claws.

II. Students lay asphalt roll roofing.

WOOD

CONTENT TITLE: Roll Roofing

SUB OBJECTIVE 13: The student will demonstrate ability to apply roll roofing using concealed nail method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying asphalt roll roofing using concealed nail method.

A. Prepare deck and apply felt, ridge, valley and eave flashing, etc.

B. Lay out a 9' wide edge strip overhanging eaves 1/2" to 3/8". Nail with roofing nails, 4" apart, 1" from edge of strip.

C. Overlap edge strip with roll roofing sheets, securing lower overlap with asphalt cement.

D. At upper edge, nail, nailing 4" apart and 2" at most from upper edge.

E. Lay out next sheet to overlap previously laid sheet(s) by at least 3". It is important that sheets be parallel, so each course should be marked with a chalk line. Cover lower overlap area with asphalt cement before laying sheet down.

F. Continue laying sheets up to ridge of roof. Sheets should fold over ridge both ways, and preferably, another sheet should be laid over the ridge.

G. Fold overhanging material (material should overhang rakes and eaves) down and nail or use nail-and-adhesive method to attach to roof base. This prevents water from being blown up under asphalt.

II. Students apply asphalt roll roofing using concealed nail method.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to prepare decks for and apply wood shakes and shingles to a roof.

SOURCES OF INFORMATION

Schmidt, Bennett and Lewis, Construction: Principles, Materials and Methods, (United States Savings and Loan League with the American Savings and Loan Institute Press, Architectural and Construction Research Department: 111 East Wacker Drive, Chicago, Illinois 60601), 1972.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Expansion and contraction of wet and dry cedar shingles

Communication Skills

- Technical literature
- Student Resource Manual
- Related safety
  - Working on furred decking

WOOD

CONTENT TITLE: Wood Roofing (Preparation)

SUB OBJECTIVE 14: The student will demonstrate ability to prepare a deck for application of wooden shingles.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing the deck.

A. Describe conditions under which solid or spaced sheathing is used for wooden shingles.
B. Discuss techniques of underlayment and interlayment.
C. Clear decking of chips, debris and other stray material.
D. Ensure that nailing schedule is complete and that no nail heads protrude.
E. Install eaves flashing strip.
F. Install cant strip along rake edges of roof and trim flush with eaves.

II. Students prepare a deck for application of wood shingles.

WOOD

CONTENT TITLE: Wood Roofing (Preparation)

SUB OBJECTIVE 15: The student will demonstrate ability to install valley flashing preparatory to the application of wooden shingles.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing valley flashing for a wood shingle roof.

A. Lay a strip of saturated felt (usually 30 lb. or more) over underlayment (if any) up the valley to be flashed.
B. Purchase ready-made or cut from sheet metal, (usually no lighter than 26 gauge) strips for the valley, and bend to fit.
C. If preparing own strips, paint with white lead and oil paint and allow to dry.
D. Mention that if roof pitch is one half or more, valley sheets should extend 7" or more up each side of roof; if slope is less than one half, valley sheets should extend no less than 10".
E. Carefully fit valley sheets to valleys and nail into position.

II. Students install valley flashing for a wood shingle roof.

WOOD

CONTENT TITLE: Wood Roofing (Preparation)

SUB OBJECTIVE 16: The student will demonstrate ability to flash ridges for a wood shingle roof.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates flashing ridges for a wood shingle roof.

A. Cut heavy saturated felt strips so they will extend at least 10" on either side of the ridge and nail into position.
B. Similarly, cut sheet metal strips to form top flashing layer.
C. Bend strips to fit ridges, and trim to fit top ridges and eave lines.
D. Paint metal with white lead and oil paint. Allow to dry.
E. Nail sheet metal to roof, nailing closely and with nails placed near the edge of the metal.

II. Students flash ridges for a wood shingle roof.

WOOD

CONTENT TITLE: Wood Roofing (Preparation)

SUB OBJECTIVE 17: The student will demonstrate ability to apply wood shingles on a straight course.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates shingling a roof with wood shingles.

A. Starting at eaves, apply felt underlayment strip (if required), and start applying shingles in first course. Nail close to edge of each shingle, two nails to a shingle and 1" or 2" above butt line of next course (approximately midway up shingle). Position shingles with 1/4" to 3/8" joint between each to allow for expansion of shingles during wet weather.

B. Repeat first course at least once (some roofers prefer three times as shingle wear increases with decreasing distance to the eave lines). Do not overlap any vertical joints; allow at least 1-1/2" separation between them.

C. Apply next strip of interlayment (if required).

D. Lightly tack a 1 x 2 straightedge board along upper side of succeeding course. Check horizontal alignment with a chalk line. This board will serve as a guide for applying the next course of shingles.

E. Apply next course of shingles, abutting each against the straightedge board to ensure proper alignment. Again, take care not to allow alignment of vertical joints. Use shingler's hatchet, if desired, to align course, but check alignment frequently with a chalk line.

II. Students apply wood shingles.

WOOD

CONTENT TITLE: Wood Roofing (Application)

SUB OBJECTIVE 18: The student will demonstrate ability to apply wood shingles to valleys in roofs.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying wood shingles to valleys.

A. Determine unit rise and unit run of roof and prepare a pattern for cutting shingles. (Or, demonstrate any desirable method of pattern development.)
B. Select extra-wide shingles for use along valleys.
C. Measure and cut shingles to proper miter (using pattern).
D. Work shingles up valley and lay remaining roof area working from valleys to rakes. (Note: Some constractors work the opposite direction, and some even start at the middle of the roof and work out in both directions, thus allowing two roofers to work simultaneously on any given course. It is best, therefore, to instruct the students in the techniques most prevalent in the surrounding area and merely inform him of the alternate methods that are available.)
E. Leave an open space between shingles from the two roof planes (open valley flashing). Closed valley construction is not recommended for wood shingle roofs.

II. Students apply wood shingles to valleys.

WOOD

CONTENT TITLE: Wood Roofing (Application)

SUB OBJECTIVE 19: The student will demonstrate ability to apply wood shingles to hips and ridges in roofs.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates shingling hips and ridges.

A. Apply a strip of heavy saturated felt sufficiently wide to hang over at least 6" on either side of the centerline.
B. Attach straightedge strips on each side of the centerline of the hip or ridge, 6" off.
C. On ridges, set first shingle abutting straightedge strip and nail into place, (all shingles for hips and ridges should be selected for uniformity of size -- approximately 6" wide. On hips, first course should be doubled.)
D. Strike the intersecting line for the opposite shingle, and cut shingle at this line on a bevel (plane parallel to plane of opposing roof surface).
E. Position another shingle, abutting against opposite straightedge, on opposity side or ridge or hip. Fasten and cut on a bevel, even with first shingle.
F. Start next course on side of hip or ridge opposite beginning point of first course. In this way, alternate until completion to create a basket weave pattern.

II. Students shingle hips and ridges.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to prepare the deck and to install asbestos mineral fiber shingles.

SOURCES OF INFORMATION

Schmidt, Bennett and Lewis, Construction: Principles, Minerals and Methods, (United States Savings and Loan League with the American Savings and Loan Institute Press, Architectural and Construction Research Department: 111 East Wacker Drive, Chicago, Illinois 60601), 1972.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Nature of asbestos

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Related safety
  - Working with asbestos

WOOD

CONTENT TITLE: Asbestos Shingles (Preparation)

SUB OBJECTIVE 20: The student will demonstrate ability to prepare the deck for mineral fiber shingles.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing a deck for application of mineral fiber shingles.

   A. Drive high nail heads home.
   B. Remove any rough spots or edges.
   C. Apply a wood cant strip along eaves, flush with lower edge of the roof.
   D. Fasten wooden cant strips, 2" wide and of the thickness of the shingle to be applied, parallel to eaves and ridges, and far enough apart that the shingles will just cover them. (Space = distance between courses.)
   E. Apply saturated felt paper, overlapping sides by 2", valleys and ridges by 12". Nail with closely spaced roofing nails positioned not more than 1" from cant strips.

II. Students prepare a deck for application of mineral fiber shingles.

WOOD

CONTENT TITLE: Asbestos Shingles (Preparation)

SUB OBJECTIVE 21: The student will demonstrate ability to flash valleys for application of mineral fiber shingles.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates flashing valleys for later application of mineral fiber shingles.

   A. Snap chalk lines down valley center and 6" to 12" parallel to valley center on either side.
   B. Cut strips of galvanized sheet metal 12" to 18" wide.
   C. Bend back side edges 1/2" to form water seal.
   D. Bend strips down centerline and fit flashing into valleys.
   E. Attach flashing to roof with roofing cleats. Do not drive nails into metal valley flashing for asbestos shingle application.

II. Students flash valleys for later application of mineral fiber shingles.

WOOD

CONTENT TITLE: Asbestos Shingles (Basic Operations)

SUB OBJECTIVE 22: The student will demonstrate ability to perform basic cutting, drilling and fastening operations peculiar to asbestos shingles.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates cutting and punching asbestos shingles using special tools.

   A. Demonstrate use of mineral fiber cutting machine.
   B. Demonstrate use of mineral fiber nail hole punch.

II. Instructor demonstrates scoring and snapping asbestos shingles.

   A. Measure and locate desired cut line.
   B. Scribe or score snap line using carbide tipped blade.
   C. As in cutting glass, lay shingle on a flat surface scribe line near edge.
   D. Grasp protruding end firmly and press down with a quick snapping motion; the shingle should snap along the score.

III. Students work with asbestos shingles.

WOOD

CONTENT TITLE: Asbestos Shingles

SUB OBJECTIVE 23: The student will demonstrate ability to shingle a roof with asbestos shingles.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses shingling roofs with asbestos.

A. Discuss basic similarity between this work and that of shingling roofs with wood shingles.
B. Demonstrate the various types of prefabricated materials available; i.e., demonstrate application of prefabricated eave starter strips, hip and ridge shingles and ridge rolls.
C. Discuss the various approaches contractors may take to shingling roofs with asbestos, and the reasons for these working patterns.

II. Students shingle a roof with asbestos shingles.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to prepare the decking for, and to apply materials for a built-up roof.

SOURCES OF INFORMATION

GAF Built-Up Roofing Specifications, (GAF Corporation, Building Products Division: 140 West 51st Street, New York, New York 10020), 1972.

Bureau of Naval Personnel, Builder 3 & 2, NAVPERS 10648-F, 1970. (Order from GPO, Document No. D208.11: B86/3/970.)

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Common roofing materials and properties including new urethane slabs used in roofing

Communication Skills

- Manufacturer's literature
- Related safety
  - Handling "hot stuff"

WOOD

CONTENT TITLE: Built-Up Roofs (Preparation)

SUB OBJECTIVE 24: The student will demonstrate ability to prepare the deck for application of a built-up roof.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing the deck.

A. Clear deck of any debris or other extraneous material.
B. Emphasize the appropriate incline must exist for built-up roofing to function properly.
C. Point out that plywood decking should not bend, detectably, under an average man's weight.
D. Demonstrate reparing any cracks, knotholes or other interruptions in integrity of deck surface with sheet metal.
E. Emphasize the fact that concrete decks must be absolutely dry before work may begin.

II. Students prepare a deck for application of a built-up roof.

WOOD

CONTENT TITLE: Built-Up Roofs

SUB OBJECTIVE 25: The student will demonstrate ability to lay a built-up roof.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying a built-up roof.

A. Cover deck with a uniform layer of hot asphalt. This may be done by mopping, spraying, rolling, etc. Safety should be emphasized throughout demonstration of built-up roofing.
B. Set cant strips at juncture with vertical surfaces.
C. Beginning at low point of roof, roll out felt.
D. Roll out succeeding layers, working up the slope, and overlapping liberally. Apply asphalt to areas to be overlapped and roll seams down with a heavy roller. An intimate bond is required between each layer of felt.
E. Cut felt to fit around vent pipes, ductwork, etc. and flash as in asphalt roofing applications.
F. Apply required number of layers and top off with a layer of roofing gravel.

II. Students lay a built-up roof.

WOOD

OVERALL OBJECTIVE: The student will demonstrate ability to re-roof over asphalt, asbestos and wood roofs and to estimate the materials required for roofs.

SOURCES OF INFORMATION

GAF Built-Up Roofing Specifications, (GAF Corporation, Building Products Division: 140 West 51st Street, New York, New York 10020), 1972.

Schmidt, Bennett and Lewis, Construction: Principles, Materials and Methods, (United States Savings and Loan League with the American Savings and Loan Institute Press, Architectural and Construction Research Department: 111 East Wacker Drive, Chicago, Illinois 60601), 1972.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Estimating the whole roofing job
- Reviewing math requirements for job entry or higher education

Communication Skills

- Student Resource Manual
- Related safety
  - Checking existing roofing
- Review of communication skill requirements for job entry or higher education
- Review opportunities available to students
  - Job
  - Apprenticeship
  - Technical or professional

WOOD

CONTENT TITLE: Re-roofing

SUB OBJECTIVE 26: The student will demonstrate ability to apply asphalt strip shingles over an old wood roof.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying asphalt strip shingles to an old roof, previously roofed with wood shingles.

   A. Ensure that existing deck is strong enough and sound enough to support the new roof.
   B. Remove all loose or protruding nails.
   C. Renail shingles in new locations.
   D. Nail down loose shingles and warped or split shingles.
   E. Replace any missing shingles and cut back shingles at eaves and rakes.
   F. Apply 4" or 6" wide, 1" thick wood strips to deck, projecting them outward as far as the old wood shingles protruded.
   G. Apply backerboard or beveled feathering strips along butt edges of old shingles, nailing with 4d nails, 6" apart.
   H. Apply strip shingles to prepared surface as in new applications.

II. Students re-roof an old wood roof with asphalt strip shingles.

WOOD

CONTENT TITLE: Re-roofing

SUB OBJECTIVE 27: The student will demonstrate ability to apply new asphalt strip shingles over an old asphalt shingle roof.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying new asphalt shingles to a similarly roofed structure.

   A. Nail down or cut away loose or curled shingles.
   B. Remove any protruding nails, and replace worn edging strips.
   C. Apply new flashing material along junctures of roof deck with vertical surfaces. Likewise, reflash hips, valleys and ridges as in new roof applications.
   D. Apply shingles as in new roofing except:
      1) use nails 1/2" longer than normal;
      2) when shingling up to vertical surfaces, use a caulking gun to run final bead of cement between shingle ends and siding;
      3) spread asphalt cement over felt strips as shingles are laid and embed new shingles in cement.

II. Students apply new asphalt shingles over old asphalt shingles.

WOOD

CONTENT TITLE: Re-roofing

SUB OBJECTIVE 28: The student will demonstrate ability to apply new wood shingles over an old wood shingle roof.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying new wood shingles over old.

A. Nail down or replace all warped, split or decayed shingles.
B. Cut off first two rows of shingles along eaves and nail a 1" strip in its place with outer edge flush with eave line.
C. Raise level of valleys by installing wood strips and new flashing.
D. Remove hip and ridge shingles. Remember to space new shingles about 1/4" apart.
E. Apply first course of new shingles to project 1/2" to 3/4" beyond edge of roof.
F. Apply second layer of shingles over first, and then continue upwards as in new roof applications, using 5d or 6d nails, (rust resistant).

II. Students apply new wood shingles over old.

WOOD

CONTENT TITLE: Estimating

SUB OBJECTIVE 29: The student will demonstrate ability to estimate roofing material.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating roofing material.

A. Determine total ground area of structure including eaves and corner overhangs.

B. To this total, add a percentage of the total as determined by roof slope. Percentages are as follows:

3 in 12	add 3%
4 in 12	add 5-1/2%
5 in 12	add 8-1/2%
6 in 12	add 12%
8 in 12	add 20%

C. Allow an additional 10% for waste.

D. Alternately, use plane geometry to determine roof area, and add 10% for waste.

II. Students estimate roofing material.

APPENDIX

WOOD

OVERALL OBJECTIVE:	The student will demonstrate ability to level, fit, install and trim out prefabricated cabinetry.
SUB OBJECTIVE:	To install prefabricated paneling.
TOOLS AND MATERIALS:	Paneling, furring strips, saws, dividers, tape measure, nails, adhesive and adhesive applicator.
I. Preparation	Read Brann, How to Apply Paneling, pp. 10-23.
II. Presentation	Instructor demonstrates installing prefinished paneling.
III. Application	Students install prefinished paneling.
IV. Performance Tests	

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ABSTRACT: THIS STUDENT RESOURCE MANUAL FOR CAREERS IN WOODWORKING IS INTENDED TO SERVE AS A SUPPLEMENTAL TEXT AND INFORMATION MANUAL. IT IS DESIGNED AND WRITTEN FOR STUDENT USE AND IS STRUCTURED TO COMPLEMENT THE INSTRUCTOR'S GUIDE FOR WOOD (VT 102 407 IN THIS ISSUE). UNIT TITLES ARE: FORM CARPENTRY, FRAME CARPENTRY, ROOFING, FLOORING, TRIM CARPENTRY, SAFETY, AFTER GRADUATION, AND TOOLS AND EQUIPMENT. THE JOB ITSELF AND THE TASKS INVOLVED IN DOING THAT JOB ARE DISCUSSED IN EACH UNIT. A GLOSSARY IS ALSO INCLUDED AND RESOURCES ARE LISTED IN THE APPENDIX. (AUTHOR/LJ)

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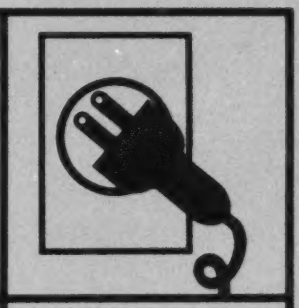
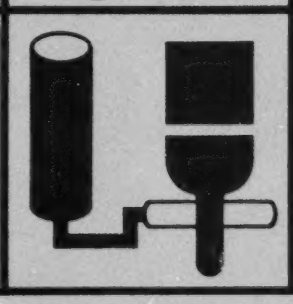
WOOD





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WOOD

construction industry series
student manual
preparation level

4

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This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

Exploration Level:

Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

Occupational Preparation Level:

Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
Metal - Student Manual
Metal - Instructor's Guide
Electricity - Student Manual
Electricity - Instructor's Guide
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Articulation Guide - Construction Industry Series

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INTRODUCTION TO WOOD

This manual will assist you in a number of instructional programs in wood work. For many, the skills acquired in one or more of these wood training programs will lead to a job in the construction industry after high school graduation. Others may decide to go on to a junior or senior college for further training. In any event, you have made a basic decision to prepare yourself for a career in the construction industry.

It should be emphasized that your training in wood will be broad enough to permit a number of job possibilities. The skills and knowledge you will learn can be applied to other areas within the construction industry and even other industries. For this reason, you should not feel "locked into" any wood course. Whatever jobs you may eventually hold in construction, in the trades, technical, professional, management or distribution areas, your experiences and preparation in wood classes will help. You will be leaving high school with more than just a diploma. You will be starting out in the front half rather than the back half of the employment lines. You will have something to offer an employer.

So while you are still in school, look around to see what is offered and how it can advance your future career in construction. Math classes will offer training in computations, whole numbers, fractions and decimals. Measurement is a must. Ability to measure with accuracy is a skill demanded by a technical society.

English or communication skill classes will strengthen your abilities to write, talk, draw, read and listen. These, too, are valuable tools for you to get and hold the kind of job you want.

Science classes will increase your understanding of the world around all of us. This understanding is important and becoming more important to anyone in construction. Whether it be electromagnetic force or certain insulation qualities of materials or hydraulics or ecology, science classes will help deepen your awareness and understanding of the work you do and the materials you use.

Social science courses will assist your broad understanding of our political, social and economic system. To appreciate the past will increase your awareness of the changes which affect all of our lives today.

Other areas which can help you and areas which are probably available to you through your high school are student clubs and associations — VICA, DECA, FFA, FHA, OEA and FBLA. These clubs may help many develop leadership skills and pride of workmanship.

All of these areas described are probably available at your high school. There are many others that can help those who have made a basic career decision. It is hoped that you are one of those students who have chosen your future career area, rather than allowing chance to find you a job.

Good luck to you in construction.

FORM CARPENTRY

Form carpenters erect forms into which concrete is poured. Their work must be exact. After the forms are removed the concrete will stand as a permanent representation of their work. They must be able to read blueprints, sketches or building plans to determine measurements and types of material. They must coordinate their work closely with plumbers, electricians, cement finishers and others. Form carpenters select materials and cut, fit and assemble them. The work involves a great deal of activity but stamina, rather than brute strength, is emphasized. Forming work requires one to stoop, crouch, lift, crawl, climb and reach. Reasonably good vision (normal or corrected) is required to use the plumb bob, measuring rule and level to check for trueness and squareness. A working knowledge of fundamental math is necessary for working with whole units and fractions and to figure areas and volumes.

Various types of material are used in the construction of concrete forms. The type of material used largely depends on the type of construction, the area the construction site is in, and the availability of certain materials to the contractor.

In a small do-it-yourself operation or home improvements, the materials used more than likely would be chosen with the intention of reusing them later. On the other hand, a large commercial builder might keep a full stock of many of the latest panel forms. These are prefabricated panels made of plyform on metal frames, or of fiber glass, hardboard or other materials. Many of these are available with inverse patterns which leave the finished concrete with any of a number of designs varying from wood grain to geometric patterns.

Standard framing lumber is used extensively in form construction along with a number of other products. Softwoods are most often used, and they are sold and referred to in nominal sizes of 2 to 4 inches in thickness and 4 to 12 inches in width. Tongue and groove and shiplap sheathing are also used in form construction in the nominal sizes of 1 inch thick and up to 10 inches wide.

Special plywood such as plyfoam has the advantage of a high reuse factor in that it is oil-saturated and resists moisture penetration. Regular exterior plywood and hardboards are also used.

Double-headed and regular common nails are used as fasteners along with bolts and lag screws. The double-headed nails ensure secure holding power and yet can be readily pulled when it is time to strip the forms.

Various types of combination metal and wall ties and spreaders have largely replaced the old wooden spreader and the wire tie. Among these are the wedge-type tie rod and spreader, lag screw-type tie rod and spreader, and the button and wrench-type tie rod. Most of these are easy to install and adjust and help ensure that the form will be uniform. To release the forms, slightly different methods are employed. Some of these devices unscrew leaving the inner portion in the wall. Others release the form readily, but leave the connecting rods protruding from the finished concrete. In this case the ends are broken off just next to the concrete surface by means of a special tool.

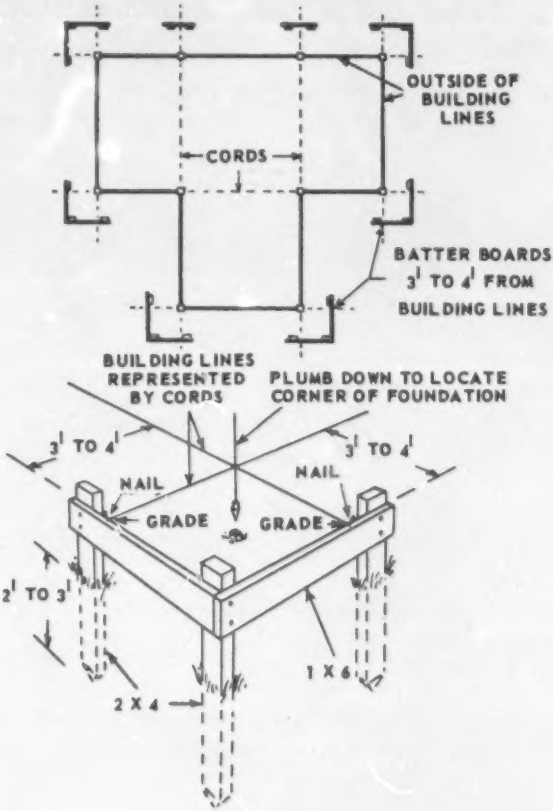
Now we will consider some of the processes utilizing these materials. Most people associate carpentry with only the wood construction industry, but anyone associated with building operations is aware of the close and vital relationship of the carpenter to the concrete industry. Even in large commercial buildings built of steel and reinforced concrete there is a large amount of work the carpenter must do.

In such cases it is usually the carpenter who builds the forms from which the concrete is shaped. On many jobs, such as single residential dwellings, the carpenter is expected to lay out the building lines, set the forms and oversee the placing of the concrete foundation.

The lot lines should always be established by a licensed surveyor — carpenters should not be expected to establish property lines. Once the location has been established by the owner or builder, the carpenter may lay out the building lines. There are several instruments which are normally used to establish building and grade lines, although it is often possible to lay out a building using only measuring tapes, stakes, string, etc. Foremost consideration should be given to laying out the foundation on the level and square. An out-of-square foundation will create problems continually thoughout the construction of the building. Once a side line has been established, it is necessary to set perpendiculars to this line to mark the outer corners of the foundation wall. This can be done by using the 3-4-5 right angle method. To use this method, measure from the corner stake 6 feet down one line, and 8 feet down the intersecting line. The distance between these points will be exactly 10 feet if the corner is square. Squareness should be checked again after the guiding lines are established by measuring the diagonals of the squares and rectangles formed. The two diagonal measurements of any square or rectangle will be the same if the square or rectangle is true. As the lines are established, stakes should be set and a tack should be placed in the top of the stake to represent the outside corners of the foundation walls.

BATTER BOARDS AND EXCAVATION

Right angle batter boards should be set up 4 feet or more away from each stake representing an outside corner of the building. It is sometimes necessary to set up straight batter boards to receive a single line. The batter boards should be made of 2 x 4 inch stakes with 1 x 6 inch or larger materials for the ledgers. The ledgers should be nailed to the stakes in a level position at a height that will be slightly above the top of the foundation. Lines should now be pulled from one batter board to another using a plumb bob to align them with the layout stakes. These lines should be attached to the batter boards by marking where they cross. To do this, hold them out of the way while a small saw kerf is cut in the board; then set the line in the kerf and either tie it to a nail or wrap it securely and tie it.



After the batter boards have been erected and all lines are aligned with the original layout stakes, excavation may begin. During the excavation, (which must be done according to the building specifications) the layout stakes will be dug out and the lines from the batter boards removed. Care must be taken during the excavation not to disturb the batter boards, for they must be restrung to establish the building lines after the excavation has been completed and the actual form construction is ready to begin.

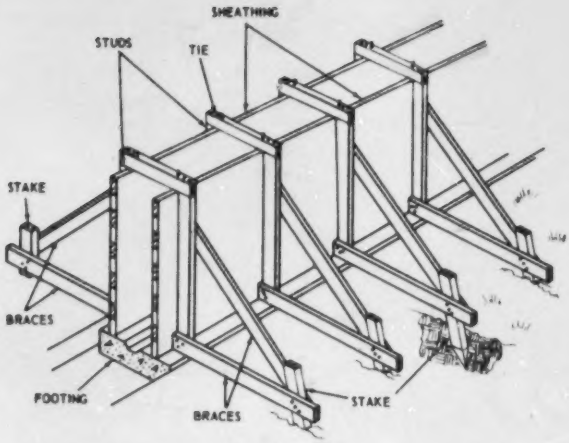
FORMS FOR FOOTINGS

If footings are called for in the building plans, their forms must be built after excavation has been completed. Lines are replaced on the batter boards and corner points are re-established by using a plumb bob. Grade stakes are driven so that the tops are on a level plane at the top of the footing and are used to establish the location and height of the outside wall of the footing. If one-inch boards are to be used as forms, supporting stakes should be driven every 2 to 3 feet. If two-inch material is used, the stakes may be further apart. After the outside wall of the footing is in place, the inside wall is built by using a spreader to establish the distance and a carpenter's level to establish the top level. It should be kept in mind that all forms are temporary and will later be removed. Double-headed nails should be set through the stakes and into the form boards, rather than the other way around. The forms must be secure in order to hold the weight of the plastic concrete, but they must also be built in such a manner that they can be removed without ruining the forming material or damaging the fresh concrete. When the forms are complete, a check should be made for sturdiness and accuracy and all lines and stakes removed. The forms are now ready for the reinforcing steel and concrete.

WALL FORMS

Wall forms must be exceptionally strong and well-braced in order to withstand and firmly hold the pressure of plastic concrete. Regular concrete weighs about 150 pounds per square foot. This means that if it were poured into a wall one foot thick and eight feet high, in one pouring it would create pressures of about 1,000 pounds per square foot along the bottom of the form. An experienced form carpenter is well aware that it takes much less time to build a form correctly than it does to clean up and repair a form that breaks during the pouring.

Many different types of wall forming systems are available to the form carpenter today. Prefabricated panels are used for most wall forming because they save the contractor both time and money.



They can be quickly erected and are reusable. Certain basic fundamentals should be applied to all systems, whether the forms used are hand built or prefab panels. Joints between form boards or panels must be tight to prevent loss of cement paste which would weaken the concrete. Such a loss can also result in honeycombing. The forms should be free of any defect which would cause a blemish on the concrete. They should be securely braced and tied to prevent a bulging or uneven finished product. All forms may be assembled from 1 inch sheathing boards or from 3/4 inch plywood using 2 x 4 inch studs on 2 foot centers. If walls are to be higher than three or four feet, they must be backed by whalers.

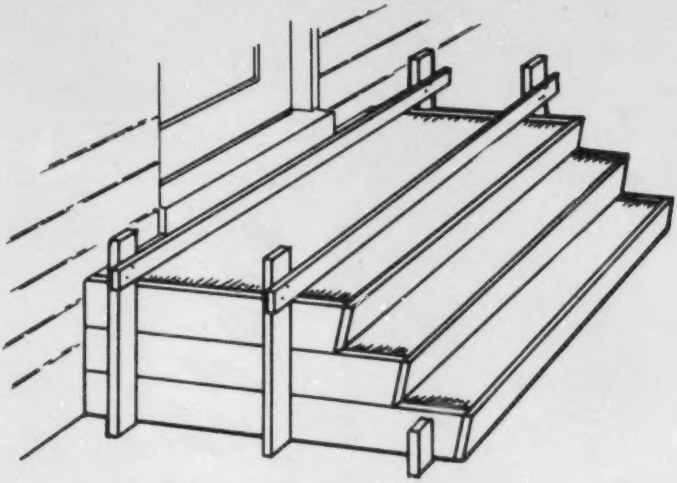
Several products now generally replace the use of wooden spreaders and wire ties to keep the walls a uniform thickness. Whatever method is used, the side of a wall form must be securely tied together to keep it from spreading under the weight and pressure of the plastic concrete.

SLAB CONSTRUCTION

Residential structures, as well as commercial structures, are often built on slab foundations. When this method is employed, the concrete is poured directly on the prepared ground. The forms necessary for the outside walls of this type of foundation are positioned and leveled in much the same way as the footing walls described earlier. Foundation beams and footings require no forms, for these are created by the removal of compacted fill dirt. In other words, these ditches become earthen forms.

STEPS, SIDEWALKS AND DRIVEWAYS

Any porch, entrance, platform, or steps of considerable size should be constructed as an integral part of the foundation. If this is not possible, it should be firmly attached by leaving reinforcing rods protruding to it as "ties." When steps are being formed and are more than three feet in width, 2 inch stock should be used as riser forms to prevent the steps from bulging.



Sidewalks and driveways are usually not laid until the construction is almost complete and the earth around the structure is graded and leveled. They are usually poured directly on the soil and the only forms necessary are 2 x 4's staked to the ground and leveled. Expansion joints should be made wherever they connect with the structural foundation.

SAFETY CONSIDERATIONS

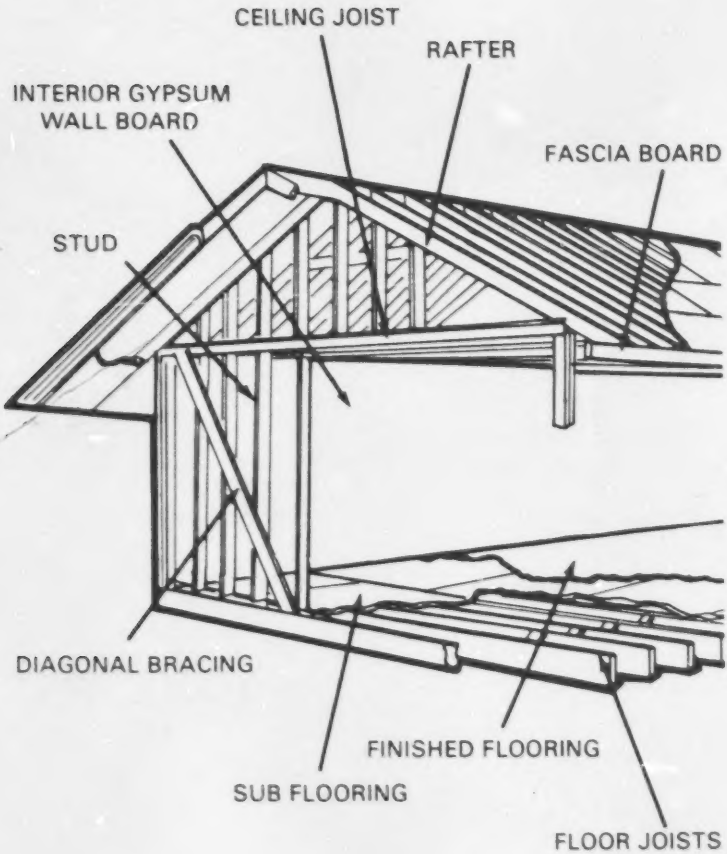
The element of danger involved in concrete form building can vary greatly according to the type of work being performed. This is easily seen by considering the possible difference in severity of an accident happening to a person building a residential sidewalk form as compared to a form builder working on a scaffold hundreds of feet above the ground. Every construction job has inherent dangers, and it is usually the responsibility of the individual worker to recognize and avoid them.

When building forms for even larger structures, it often becomes necessary to move tools and materials to a higher or lower level.

Rigging is usually necessary to move large pre-fab panels, timbers and so forth. Rigging equipment should always be checked before use. Never stand in the sight of a line or under a load being moved. A safety-minded worker will use a handline rather than attempt to climb a ladder with hands full of tools. Whenever bundles of material are to be hoisted, special attention should be given to rigging because of the danger of slippage.

In form work, you will sometimes be working around excavations, and here carelessness can be fatal. Never climb into an open ditch until it is shored properly; never work alone around excavations; use extra caution when working near the top or bottom of an opening.

On most construction jobs, form carpenters are required to be present during the pouring of the plastic concrete. They are to check the forms for weak points as the pour is made and be on hand should repairs become necessary. They also oversee the forms and prevent any damage to them by the heavy pouring equipment. At this time it is absolutely essential that form carpenters use extra caution and stay clear of danger areas.


CEILING JOIST
RAFTER
INTERIOR GYPSUM
WALL BOARD
FASCIA BOARD
STUD
DIAGONAL BRACING
FINISHED FLOORING
SUB FLOORING
FLOOR JOISTS

FRAME CARPENTRY

Carpenters who specialize in erecting frame buildings and perform general carpentry in residential construction are designated as framing carpenters. They erect the wooden frame work in buildings including the decking, sub-flooring, sheathing partitions, floor joists and studding rafters. They must be able to read blueprints, sketches or building plans to determine measurements, as well as the types of materials required. They select the proper materials, saw, fit and assemble them using such fasteners as nails, bolts or screws. The work involves a great deal of activity but stamina, rather than brute strength, is emphasized. Framing carpenters must be able to add, subtract, mutiply and divide fractions, as well as whole numbers, and must have a working knowledge of fundamental geometry to be able to figure dimensions of squares and triangles in square feet.

There are many kinds of wood available for wood frame construction. The usual characteristics of these woods are: High stiffness, good bending strength, good nail-holding power, hardness and absence of pronounced warp. For framing, dryness and size are as important as the inherent properties of the wood. It is almost as important to properly store and protect the materials at the building site as it is to choose the correct material.

GRADES USED IN FRAMING

The usual softwood grade for all framing, in terms of both high and medium cost construction, is Number 1 Dimension. Number 2

Dimension is satisfactory once it is in place, but it is not as straight or as easy to use as Number 1. Number 3 Dimension is used for studs and joists in low-cost homes, especially where short pieces can be used effectively. Other grades are listed below.

Sub-Floors and Roof Boards:

No. 2: Commonly used in better construction.

No. 3: Found in more economical construction. C-D sheathing plywood is also often used.

Wall Sheathing:

No. 4 and No. 5: Sometimes used in low-cost homes, but not readily available in many kinds of wood.

No. 2 and No. 3: Commonly used. Plywood in grades C-D or C-C are also used. Insulating board is usually used as sheathing when a brick veneer is applied.

SIZE CLASSIFICATIONS

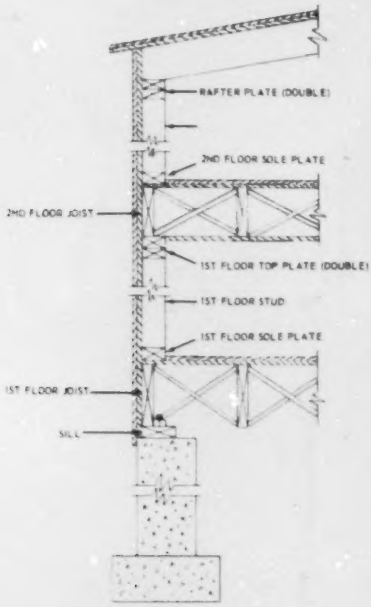
Sizes describe not only the nominal dimensions of lumber, but distinguish between the various classifications as well.

- *Board lumber* is 2 or more inches wide and 3/4 of an inch or thicker.
- *Light framing* is 2 to 4 inches wide and 2 to 4 inches or thicker.
- *Industrial light framing* is 3 to 4 inches wide and 2 to 4 inches thick.
- *Joists and planks* are 6 inches or wider and 2 to 4 inches thick.
- *Beams and stringers* are 5 or more inches thick with a width more than 2 inches greater than the thickness.
- *Posts and timers* are 5 inches wide by 5 inches deep and thicker with a width not more than 2 inches greater than the thickness.
- *Decking* is 4 inches and wider and 2 to 4 inches thick.
- *Siding* thickness is expressed by the dimensions of its butt edge.
- *Moldings* of any profile are described by their size at the thickest and widest points.

All framing work is based upon three fundamental processes. A framing carpenter must first be able to recognize and select the proper material to be used; measure and cut these materials to the proper shape and size; use fasteners to secure the material in its proper place.

RECOGNIZING AND SELECTING MATERIAL

The size, kind and grade of material to be used are seldom left to the framing carpenter's discretion. This information is usually given verbally by a supervisor or written in the form of sketches or blueprints. For example, it is not ordinarily the framer's responsibility to decide to use No. 2 yellow pine 2 x 10 inches as joists; but if this is what is specified, the framer must be able to recognize and find this among the various materials delivered to the construction site. It would be an extreme waste of material and time for a worker to cut 20 foot pine 2 x 4's into studs, when pre-cut spruce was intended for studding. A framing carpenter must be able to determine common grades and kinds of woods, sheathing, wallboard and other building materials.



MARKING AND CUTTING MATERIAL

A framing carpenter must be able to measure, mark and cut various building materials to specified dimensions. Good, close fitting framing requires skill in the use of measuring instruments and good judgment in determining the degree of accuracy necessary for a particular operation. Loss of time and materials due to errors in measuring, marking or cutting can rarely be afforded, especially considering today's high cost of materials.

The following are some habits which should be developed early, in order to increase measuring, marking and cutting accuracy:

1. Check the end of stock for squareness before measuring.
2. Always measure along one edge when measuring lengthwise.
3. Use measuring and marking tools *only* for measuring and marking (never use a square for tapping or prying boards, nails, etc.).
4. When cutting many boards to the same shape and size, always make a template, jig or pattern.
5. When marking material for cutting, always indicate on which side of the line the kerf is to be.
6. When marking for positioning, always indicate the position of the member.
7. Hold the pencil or marking instrument at the same angle throughout the distance of a mark.
8. Use a sliding T bevel to transfer angles from one member to another.
9. Use a chalk line for snapping or marking long, straight lines.
10. When cutting material, use the blade or tool designed for that particular material or method of cutting.

SECURING MATERIALS IN PLACE

Nailing is used almost exclusively in wood frame construction where the material used is 2 inches thick or thinner. Bolts, lag screws and other metal fasteners are often used when working with heavy members. In prefabricated trusses, wall sections, etc., and in modular construction, glue, staples and gussets are often used in combination with nails.

Nailing still remains the basic method by which the framing carpenter secures material into place. There are three methods of nailing. Face-nailing is the most commonly used method and simply means driving the nail through an open "face" of a piece of material into another. Toe-nailing, in which nails are driven at an approximate 30° angle to the grain, is the preferred method of securing studs to a sill or plate. Blind-nailing is the usual method of nailing tongue and grooved flooring. The nail is driven at an angle on the edge of the member and is so positioned that the placement of the next board will cover the exposed head of the nail.

In wood frame construction, the most commonly used type of nail is the common wire nail. Other nails, including those with spiral or

angular grooves, have exhibited greater load carrying capacities, but they are often reserved for special purposes. The common nail has its greatest strength when driven perpendicular to a load or stress. The framing carpenter must develop skill and coordination in nailing if he is to keep pace on the construction site. One should normally be able to set a 16d nail in three strokes of the hammer, and should be able to "feed" nails to the work by placing the next nail to be driven in its place at the same time the previous nail is receiving its setting stroke.

In many prefabricating shops, and often on large construction jobs where mass nailing is done in a limited area, a pneumatic or air-driven nailer is used. This tool is loaded with specially designed nails which are completely driven or set with a simple pull of a trigger. Due to the need for a compressor and an air line, and because of the weight of the pneumatic nailer, its use has limited applications. A more portable tool is the powder-actuated nailer, which drives nails with a .22 or larger caliber cartridge.

When positioning material for nailing, the framing carpenter must be aware of the methods of measuring and marking. Many errors are made by butting a member up to the wrong side of a line or by butting up to an "on center" line.

SAFETY CONSIDERATIONS

The General Safety Considerations sections at the back of this manual cover most of the safety hazards and precautions applicable in framing operations. There are a few specifics which should be kept in mind, however.

There is always the danger of falling from exposed rafters or joists, or of dropping tools or materials on workers below. Powder actuated nailers can be extremely dangerous — particularly in the hands of an inexperienced worker or if any of the built-in safety mechanisms are malfunctioning.

Hard-toed shoes with good rubber soles are highly recommended for this type of work.

ROOFING

Today's roofing industry is a multi-million dollar operation and continues to expand and grow. In an industry as vast as this, job requirements vary from menial, routine jobs to highly developed ones requiring highly skilled people. Many of these jobs are interrelated and require similar skills and knowledge. Some, however, are quite unique among themselves and require a particular skill or talent. Almost all have similar beginnings, with the basic knowledge and skills of fundamental carpentry and roofing.

Most roofers entered their field in one of two ways. Some entered carpentry through the formal apprenticeship program in general carpentry and then specialized in roofing. Others simply began with a job as a helper or laborer and, with time and experience, worked their way to being a roofer.

Today's roofing industry has become so diverse that it is entirely possible for a person to be skilled in one type of roofing, such as the applications of wooden shingles or shakes, and be completely unfamiliar with another type of roofing, such as the application of fiber glass-resin roofs. Also the kinds of work vary considerably. A person working with built-up roofs, used in large industrial buildings, would be using machines and equipment that would often be foreign to the residential roofer, (approximately 90% of residential roofs are asphalt shingle). Women are employed by some roofing companies to help the customer choose colors and designs to match their needs and desires. All of this indicates that today's roofing industry has become highly complex with the result of creating more specialized positions. The salesperson, estimator, warehouseman, decorator, truck driver, kettleman, laborer, chemist, skilled craftsperson are all a part of the roofing industry.

The more varied experience a person has, the greater one's opportunities for advancement in this industry. In order to get experience in the many different kinds and methods of roofing applications, many young people work for a roofing company which does many kinds of roofing rather than specializing in one area.

ROOFING MATERIALS

These are the materials common to most types of roofing:

- *Roofing nails*. There are many types of roofing nails and each is designed for a specific purpose. A roofer should always use the proper nails and never substitute regular nails. All roofing nails are made of materials which withstand exposure to the elements with a minimum of deterioration. Most commonly used roofing nails are made of galvanized steel, although copper, aluminum and brass are used in some applications. The roofer should follow the manufacturer's recommendations for the roofing product that he is using.
- *Asphalt-saturated felts*. Felts that have been completely saturated with asphalt can be purchased either perforated or unperforated in the following sizes:

  15 lb. felt in 4 square rolls 36 inches wide, 432 square feet. Weight: 60 lbs. per square roll. (Sometimes sold in 3 square rolls.)

  30 lb. felt in 2 square rolls 36 inches wide, 216 square feet. Weight: 60 lbs. per square roll.

  40 lb. felt in 2 square rolls coated on both sides, 216 square feet 36 inches wide. Weight: 80 lbs. per roll.

FLASHING MATERIAL

Flashings are of various materials and often the roofing materials themselves are used. Galvanized iron, copper, turnplate, sheet lead and plastics are used as flashing. Glass fabrics, cotton fabric, jute fabric, Irish flax felt and synthetic rubber are also used.

CAULKING COMPOUNDS

Caulking compounds fall into three basic categories: Rubber now curing, rubber semi-drying and self-curing. Black asphalt, asbestos fiber plastic is the most commonly used caulking compound. Caulking material is available in cartridges for caulking guns, by the gallon and in 55 gallon drums.

COMPOSITION ROOFING

Asphalt prepared roofing:

- *Mineral surfaced roll* - available in 1 square rolls, 36 inches in width, weighing 90 pounds per square. It may be applied with nails exposed or covered, comes in a variety of colors and is one of the most economical roofing materials.
- *Pattern edge roll* - as above, but furnished in split rolls designed to give an edge pattern when applied to a roof. It weighs 10 pounds per square.
- *19 inch salvaged double coverage roll* - usually has mineral coverage on the half of the roll to be exposed. Weighs 110 to 120 pounds per 2 square roll. This material is especially suitable for roofs with very low pitches.
- *3 tab, self-sealing strip shingles* - available in a wide assortment of colors weighing 235, 240 or 300 pounds per square. Three packages to a square, laid with a 5 inch tab exposure.
- *2 and 3 tab, Hex strip shingles* - as above, but with hexagon-shaped shingles; weighs 195 pounds per square.
- *Individual lock-down shingles* - weigh 145 pounds per square; 2 packages to a bundle.
- *Individual staple-down shingles* - as above, but with a slightly different shape for stapling.
- *Giant individual American shingles* - 12 x 16 inches rectangular-shaped, weighing 330 pounds per square. There are 4 packages per square.
- *Giant individual Dutch lap shingles* - weigh 165 pounds per square; 2 packages to a square.

RIGID ROOFING

- *Asbestos-cement shingles* - shingles made by combining cement and asbestos under pressure. Available in American, Dutch lap, hexagonal and multiple-unit styles. These shingles are very brittle, come prepunched and weigh 240 to 290 pounds per square.
- *Slate* - a form of rock which is quarried and split to form shingles varying from 2 inches to 3/8 inch in thickness and from 9 to 26 inches in length.
- *Tile* - roofing tile is available in 3 basic styles: Spanish, Mission, and shingle. It is made of kiln fired clay and may weigh from 1,000 to 1,500 pounds per square.

BUILT-UP ROOFS

- *Asphalt* - a by-product of the petroleum industry used for adhering the felt layers of built-up roofs together. Roofing asphalt is available with various melting points.
- *Coal tar pitch* - the first adhesive used to make built-up roofs, it is now used only on roofs with coal tar pitch felts. It is widely used for waterproofing.
- *Asphalt plastic cement* - a thick compound used for flashing, sealing and as an adhesive.
- *Cold process cement* - Similar to and used like asphalt plastic, but of a much thinner consistency.
- *Noah's pitch* - a thick compound used for flashing and sealing coal tar pitch roofs.
- *Asphalt primer* - a thin solution of asphalt and solvents. It is used as a primer coat under built-up roofs and for many damp-proofing operations on concrete, bricks, cinder blocks and other masonry products.
- *Rain patch sealer* - an asphalt-based patch sealer used for patching asphalt roofs in wet weather.
- *Cut back roof coating* - asphalt which has been diluted with petroleum solvents. Used as a protective coating and in some forms as an adhesive.
- *Aluminum coating* - an asphalt based coating with aluminum flakes suspended in solution. It leaves a bright finish and protects roofing by reflecting heat.
- *White reflecting coating* - similar in use and purpose to aluminum coating but receives its white color from vinyl or lime or a combination of both.
- *Fiber glass coatings* - a three-part product consisting of a resin base, catalyst and chopped glass fibers. These are sprayed simultaneously with special equipment.
- *Synthetic rubber roof coating* - a neoprene or similar synthetic rubber product used in special roofing applications.
- *Roof gravel* - gravel is often used as a finish material on built-up roofs. Its purpose is to decorate, reflect heat and protect the coating material which waterproofs the roof. Gravel used on pitched roofs should be 3/8 inch in diameter or larger. Natural gravel is used, as well as glazed stone, quarried marble and dolomite. Other materials used on "rock" roofs include crushed china, crushed brick and iron ore slag.

WOODEN SHINGLES AND SHAKES

- *Wooden shingles* - wooden shingles provide a very durable roof. Their main drawback is the danger of fire. Most shingles are made from red cedar, redwood and cypress. They are taper sawed and graded No. 1, No. 2, No. 3 or a utility grade. Butt ends vary from 1/2 to 3/4 inches in thickness, come in lengths of 16, 18 and 24 inches, and vary in width. They are commonly packaged 4 bundles to a square.
- *Wooden Shakes* - often referred to as the aristocrat of roofing material, wooden shakes often outlast the building itself when properly applied. Shakes are generally available in three kinds: Hand split and resawn, taper split and straight split. They are available in a variety of thicknesses and lengths and come in random widths. Weight may vary from 225 to 450 lbs. per square.

METAL ROOFING

- *Galvanized sheet metal roofing* - this roofing metal is commonly sold in widths of 27-1/2 inches and 26 inches and has standard lengths of 2 foot gradations. Galvanized sheet metal may be laid on slopes as low as 3 inch rise to the foot. This roofing material is available in several designs. Corrugated is by far the most widely used, but edge drain or "V" drain is used in many utility applications. For best results this roofing should be attached with lead-headed nails or with galvanized nails with neoprene or lead washers. In all cases, the manufacturer's specifications should be followed.
- *Aluminum roofing* - this roofing material is available in a wide assortment of designs, finishes and sizes. Many forms of aluminum roofing are made for special roofing applications; however, the most popular form is corrugated. This roofing is very light weight and highly resistant to weathering.
- *Terne metal roofing* - this roofing metal is made of a copper-bearing steel and is hot-dipped with terne metal, (80 per cent lead and 20 percent tin). A wide variety of sheet sizes are available as well as 50 feet of seamless rolls in a variety of widths. This type of metal roofing is used in a number of different types of roofing and also is widely used as flashing. For longer life and better appearance this metal should be painted.

ROOFING PROCEDURES

Regardless of the type of roofing material to be used, the first step taken by a roofer is the inspection of the decking on which

work will be done. The decking will have to support the weight of the roofing materials plus the weight of the crew and the equipment necessary to apply it. This is a very important safety factor, as well as an essential step for a good roofing job. It is an absolute necessity that the sheathing or decking be checked for weak points and poor work which may later cause leaks. It must also be measured, checked for squareness and any other factors which may later affect the quality or looks of the roof. Decking will vary greatly depending on the type of building and the kind of roofing material to be used. It may be of plywood sheathing, shiplap, center-match, a concrete slab or evenly spaced furring strips. Whatever the decking, it should always be properly checked for the type of roofing material to be used.

ASPHALT ROLL ROOFING APPLICATION

There are several types of asphalt roll roofing in general use, and all have similar methods of application. This type of roofing has several advantages in that it is easily and quickly applied. It can be applied to roofs with as little as 1 inch per foot pitch. It is about the most economical method of roofing a structure. Its greatest disadvantages are its lack of eye appeal and its relatively short life span.

Asphalt roll roofing may be applied parallel to the rake or the eaves. Felt underlayment is not commonly used on new wood decking. Regardless of the direction in which the roofing is applied, the method is the same. The roofing is unrolled in place and the exposed edge is nailed every two inches. Each roll overlaps the one previously nailed in place by two inches. This overlap is cemented with an asphalt lap cement before it is nailed. Ends are overlapped six inches, cemented and then nailed in a staggered pattern.

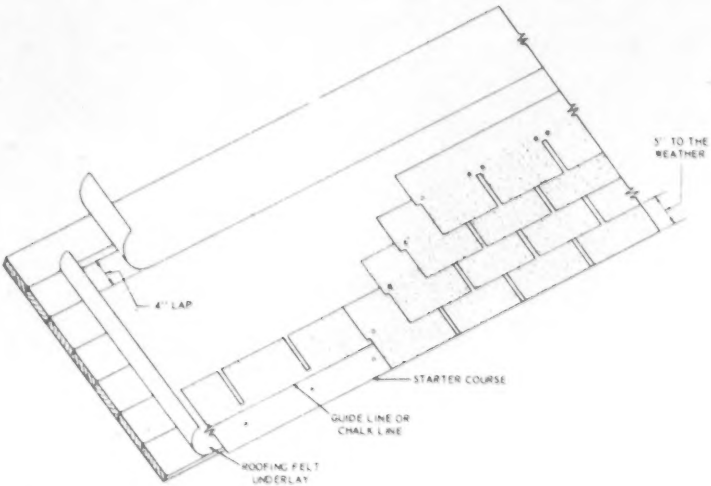
This same roofing may be applied without the nails being exposed by using the following method. Nine inch wide strips of the roofing are cut and nailed along the edges of the rakes and eaves. These strips are covered with asphalt cement as the roofing is applied. As the first roll is put into place, it is secured by cement along the lower edge and nailed along the overlap and its top edge. The overlap area, which should not be less than three inches in width, is now covered with cement and the next course applied. Hips and ridges can be covered with strips of roofing cut 12 x 36 inches and nailed and cemented into place so that the nailed ends are covered by the next pieces of overlap.

Double-coverage, selvage roll roofing is applied as described above with this exception: A strip 19 inches long in width is

applied along the eaves and none is applied along the rakes. This roofing is designed so that only 17 inches of each course has a mineral covering, leaving 19 inches of the course a natural black asphalt. This entire 19 inch wide area is mopped with asphalt cement and then covered with the next course. Each course is thus exposed 17 inches and overlapped 19 inches.

STRIP SHINGLE APPLICATION

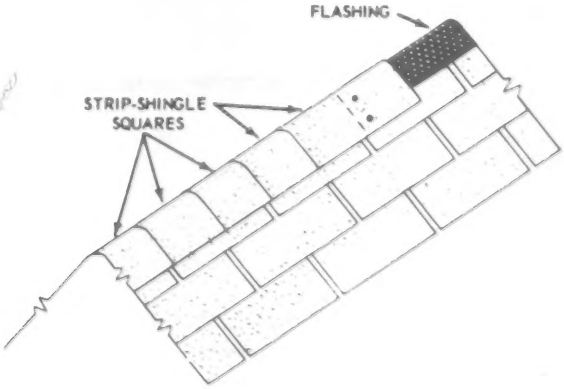
A new deck must be entirely smooth and dry before strip shingles are applied. Metal drip edges should be applied directly to the wooden deck along all eaves and rakes. Next, the entire roof area should be covered with an underlayment of No. 15 asphalt-saturated felt, overlapped at least two inches on each course. On roofs with pitches of less than four inches per foot, it is necessary to overlap the felt 19 inches, giving a double coverage. Valley flashing and eaves flashing, (if used) are then installed.



After the underlayment is complete, the roof is usually considered "dryed in" and will withstand normal rain and dew for a short time without harm to the decking. At this point it is necessary to concentrate on one area or slope of the roof at a time. To ensure more accurate vertical and horizontal alignment and to provide for meeting and matching of shingles and projections through the roof, such as dormers or chimneys, chalk lines are necessary. These lines should be snapped vertically on center on any slope and horizontally at any interval necessary to ensure proper alignment. Minor variations in the dimensions of asphalt strip shingles

are unavoidable, and the only way to control their proper alignment is by the use of chalk lines.

The next step is the application of a starter course along the eave. It is common practice to use the regular tab shingles as a starter course or starter strip. They are inverted and placed with the tabs pointing upwards, leaving a full straight edge overhanging the drip edge 1/4 to 3/4 of an inch. This starter course is fastened with roofing nails located in a line parallel to, and three to four inches above the eave edge, placed so the nail heads will not be exposed at the cutouts of the first course. The first course is applied directly over the starter course, but is placed so that butt joints will not be directly over one another and so that butt joints of the starter course will not fall between the cutouts of the tabs of the first course. On smaller roof slopes, strip shingles may be laid from either rake. On roofs 30 feet or longer, it is best to start from a center line and work towards both rakes. Three tab, square butt strips may be laid after the first course in any of several spacing methods so as to create different roof designs. When the cutout is spaced six inches off the one below it, a design is created with the tabs in line every other course. When the cutouts are spaced 12, 6, 9, 3 and 6 inches on each succeeding course, the tabs will align themselves every 5th course. These are the two most commonly used methods of spacing, but there are several others. These shingles are usually laid with five inch exposure of the tabs and are secured in place with four roofing nails per shingle. These nails are located 5/8 inch above the top of the cutouts — one nail 1 inch back from each end and one nail on the centerline of each cutout. The nails are so placed that they will be covered by the next course of shingles and so that they will not only penetrate the shingle being positioned, but the shingle on the course just

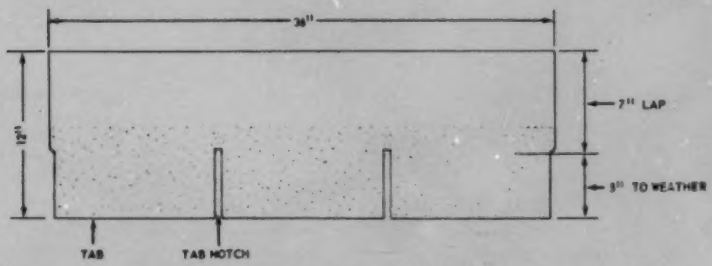


beneath it as well. Strip shingles should never be jammed tightly together as this can cause buckling.

Hips and ridges can be covered with "hip and ridge" shingles available from the manufacturer. Alternately such shingles can be cut from the regular 12 x 36 inch strip shingle by cutting them into three 12 x 12 inch pieces. Beginning at the bottom of a hip or at one end of a ridge, bend the shingles over the hip or ridge exposing them five inches. They should be secured with one nail on each side, 5 and 1/2 inches back from the exposed end and one inch up from the edge. Never use a metal ridge roll with asphalt roofing products, as it may corrode and discolor.

APPLICATION OF INDIVIDUAL ASPHALT SHINGLES

The deck should be prepared and covered with felt in the same manner as with strip shingles. These are several types of individual asphalt shingles. Some are hexagonal and designed to be interlocking, or have specially shaped tabs for stapling. Some are square; others rectangular in shape. There are different



methods of overlapping, including the Dutch lap, Giant American, and the different designs possible using the individual asphalt shingle. All of these shingles should be applied according to manufacturer's recommendations.

APPLICATION OF MINERAL FIBER (ASBESTOS CEMENT) SHINGLES

These shingles are available in a variety of colors and textures and may be obtained in rectangular, square and hexagonal shapes. Because the asbestos cement shingles are rigid and hard, nail holes are prepunched. Starting strips of hip and ridge shingles and ridge rolls are prefabricated since the material cannot be bent and formed. These shingles should be installed with needle point galvanized nails. Special shingle cutters are necessary to cut the shingles, and most of these have a punch for forming nail holes where necessary.

The roof decking must first be covered with a layer of waterproof sheathing paper. Cant strips of wood should be applied along the eaves to give the first course of shingles the proper pitch. Furring strips, the same thickness of the shingles to be used and two inches wide, are applied on each side of the hips and ridges to provide a nailing base for the hip and ridge covering. A corrosion-resistant metal, such as copper or stainless steel, must be used as valley flashing. Along the valley, shingles should be imbedded in a layer of asphalt cement for a distance of at least six inches back from where they end at the valley.

APPLICATION OF METAL ROOFING

Galvanized steel or aluminum roofing, available in corrugated or 5V crimp sheets, may be applied over solid sheathing or on 1 x 4's spaced up to 24 inches on center. No felt underlayment is necessary. Ridge roll in matching material is available for quick and easy installation. Special lead-headed nails or nails with neoprene washers are used to secure sheet metal materials to the decking. Always use the nails recommended by the manufacturer to avoid corrosion of the roofing material. Nails should be located about 12 inches apart and driven only through the top of the corrugation of the "V" crimp. Care must be taken to align the first sheet properly. If there is an error, it will be exaggerated with each additional sheet that is laid.

APPLICATION OF WOODEN SHINGLES

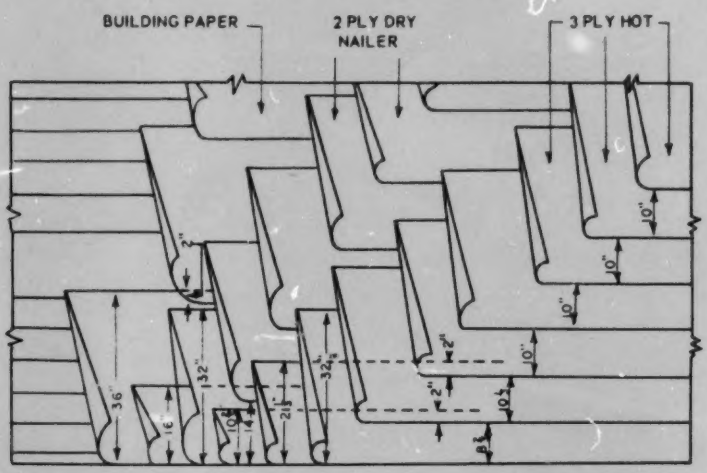
Wooden shingles may be applied to solid decking or to 1 x 3's, 1 x 4's, or 1 x 6's placed the same distance apart as the anticipated exposure of the shingles. The first course of shingles should always be doubled or tripled. Leave at least 1/4 inch between shingles to allow for expansion when they become rain soaked. Only two zinc-coated steel nails are driven into each shingle. They should be placed no closer than 3/4 of an inch from the edge of the shingle and between 3/4 and 2 inches above the exposure line. The second layer of shingles in the first course should be positioned so that the joints are no closer than 1 and 1/2 inches to the joints below. This holds true on all successive courses. Courses should occasionally be checked to make sure they are running parallel to the ridge. A board, the width of the exposure, is sometimes temporarily tacked along the butt edge of the course just laid to ensure that the next course is straight. Wherever a slope intersects a valley, the shingles for the valley should be wide and cut at the proper angle to make a neat exposure of the valley flashing.

Hips and ridges require selection of shingles of uniform width, alternately overlapped and hand beveled. Often a piece of six inch

bevel siding is applied along gable ends, underneath the shingles, wide-side out to prevent dripping from the gables.

APPLICATION OF BUILT-UP ROOFING

A flat roof or one with very little slope must be covered with a watertight membrane. Most flat roofs today are covered with built-up roofing which, as the name implies, consists of layers of felt bonded together with hot asphalt or coal tar pitch. The roofing itself is constructed on the decking as a series of layers or plys. The decking may be wood, plywood, metal, rigid insulation or concrete. The first layer, which is called a dry sheet or "slip sheet," should be applied to the decking according to the manufacturer's specifications for the type of decking to be covered.



When asphalt-saturated felt is applied to a wooden deck, it is common practice to secure it with roofing nails. Each horizontal course overlaps the preceding course two to six inches. The seams, as well as end laps, should be bonded with asphalt cement or hot asphalt. Each successive layer is mopped into place with hot asphalt or hot coal tar pitch. Every layer, except the first, is embedded in "hotstuff" and rolled immediately to eliminate pockets of air and buckles. The final roof coating should be a cold coating for a smooth finish, or "hotstuff" with slag, or 1/4 to 5/8 inch gravel embedded in it. The latter provides a weathering surface and improves the appearance. This mineral covering is applied at the rate of 300 to 400 pounds per 100 square feet. A

metal gravel stop along the edges is always necessary when the final coat is to be mineral or slag.

It should always be kept in mind that some products used in built-up roofing are not compatible. One should normally follow the manufacturer's recommendations and specifications.

REROOFING PROCEDURES

The roof repair and reroofing business is a large industry in itself. Very few roofs are designed to last as long as the building on which they are placed. Even slate, tile and cedar shake roofs, which are considered fairly permanent, can be damaged by hail, wind or freezing water and require repairs. Other types of roofing have life spans of 3 to 50 years before needing replacement. The average roof in the United States serves 12 to 18 years before reroofing becomes necessary. The type and condition of the building, as well as the type and condition of the roof, must be taken into consideration before deciding the best method of reroofing. One of the first decisions to make, is whether to remove the old roof or leave it in place. It is usually not necessary to remove old wooden shingles, old asphalt shingles or old roll roofing before appling a new asphalt roof — providing the structure can support the additional weight of the new roof, equipment, crew and so forth. The existing deck must also be sound to provide good anchorage for nails.

If it is decided to remove the old roof, it must be completely stripped to the decking. The decking should then be checked for loose boards, nails and other items, and all necessary repairs made before applying the new roof. The roofing may then be applied as a new roof.

If it is decided to put new roofing over old roofing, the procedure varies depending on the type of roofing involved. If asphalt shingles are to be installed over old asphalt shingles, one must first prepare the old roofing for covering. Ridge and hip shingles are removed and any overhang around the eaves or gable ends is cut back to the metal drip edge. Cupped shingles or tabs are split and nailed down, as are shingles which are curled or raised. The old roofing should be made as smooth as possible. New drip edges are installed over the cut back edges of the old roofing. An underlayment of felt is not usually necessary and new shingles may be applied directly to the old.

When applying new three-tab shingles over similar old shingles, the entire procedure is simplified to the following steps. A starter course is cut five inches wide and butted against the tabs of the second course of the old shingles. The first course is then cut to a

width of 10 inches and applied so that its top edge butts against the old tabs and its bottom edge is even with the lower edge of the starter course. The third and all successive courses are applied by butting the top edge of the shingle against the tabs of the old shingles. This makes a smooth reroofing job and follows the contours and lines of the old roof.

When reroofing over existing wood shingles, it is first necessary to replace any missing or badly decayed shingles. Beveled siding can then be applied along the butts of each course of the old shingles. Valleys and other flashing may or may not be replaced, depending on their condition.

SAFETY CONSIDERATIONS

There is a certain element of danger in all construction operations, but roofing is one of the more dangerous and special emphasis must be given to safety. Roofers should wear high work shoes with elevated rubber crepe soles. Heavy duty, properly fitted pants are also a must. When handling "hotstuff" one should wear a heavy, long-sleeved shirt and heavy gloves. In many situations, (and always when working on the ground during a roofing operation) it is essential to wear a hard hat.

Thoroughly check a roof surface before climbing on to it or loading it with roofing materials. Never attempt to climb, inspect or work on a steep-pitched roof without the proper safety equipment. When loading a roof with equipment and/or materials, distribute the weight according to the relative strengths and weaknesses of the roof. Use extra caution when walking or working along the eaves of a roof to guard against falling. Should you develop dizziness while on a roof, get off immediately and inform your supervisor of your condition. When laying felt, cut it to expose openings in the roof regardless of whether it is a small vent pipe opening or a huge skylight. Guard rails should be placed around the larger openings.

Ladder and scaffolding safety must be emphasized in all roofing operations. Ladders are useful and necessary, but they are a source of many accidents. Most of these accidents are caused by an unsafe ladder or one that is improperly used. The same holds true for scaffolds. Scaffolds should be properly erected and securely braced, no matter how temporary they may be.

Carelessness at any time in the handling of "hotstuff" can lead to serious accidents and costly damage. Workers who have previously never handled hot liquid asphalt or tar, should be fully instructed and closely supervised for all safety rules and regulations must be observed.

When carrying "hotstuff," be alert and avoid all obstructions in your pathway. Carry a loaded bucket slightly away from your body and avoid swinging it. A bucket should never be filled within four inches of the top. Carts, buckets and highboys of "hotstuff" should be placed convenient to the mop worker.

When pouring "hotstuff" from one bucket to another, pour slowly to avoid splashing and flashing. Should a bucket flash, the fire can be quickly extinguished by placing a piece of roofing over the bucket to smother the flames.

In filling a bucket from a highboy or other container with a spigot, keep one hand on the spigot at all times to prevent overfilling and to permit it to be turned off immediately in case of flashing.

Never carry more than one bucket at a time on any roof with a 1/4 pitch or greater.

Never carry "hotstuff" on a ladder — always use a hoist or pump. When receiving a bucket from a hoist, do not take it directly from the line. Allow it to be lowered while you guide it to a safe landing on the roof. Release the line, then pick it up.

Never walk on a sheet which has just been laid. The asphalt or tar under it may still be molten, allowing the sheet to slip out from under you.

A kettleman is the person responsible for the operation of the kettle and the area around it. This person must be experienced and fully aware of all the dangers which may exist around a kettle. Lives have been lost and hundreds of thousands of dollars of damages incurred from a single abuse of kettle operation. Safety in the kettle area cannot be over-emphasized.

The area around a kettle must be kept clear and workers in that area should wear long-sleeved clothing and gloves to protect from the possibility of burns from spills. All areas of exposed skin

should be protected from fume burns by approved skin lotion. A kettle should never be left unattended once it is lit.

Asphalt and tar should be treated according to the manufacturer's specifications. Every material used has a slightly different flash point. Care must be taken never to reach that point. Also, bituminous materials melted at too high a temperature can give off dangerous gases which may collect in the area.

When filling the kettle, chop the asphalt or pitch into small chunks which can be fed slowly into the kettle to avoid splashing. Always keep the kettle less than full to avoid splashing and slopping over and to secure better temperature control.

Never transfer a kettle when the burner is lighted. Also, before a kettle is moved, the "hotstuff" should be drawn off to the top of the tubes. The kettle should be cleaned regularly as a dirty kettle is more apt to flash than a clean one.

Every experienced roofer knows of cases where mops, long after use, have been fanned into flames which created destructive fires. A used mop that has not entirely cooled, always presents a fire hazard. Never leave used, unclean mops where they may cause fires. Even for short breaks, place mops in empty buckets or other metal containers. At the end of the day squeeze all possible "hotstuff" from the mops and then fan the fibers by twirling the mop by the handle. The mop head should then be cool enough to handle.

FLOORING

Carpenters who install wooden flooring are usually designated as finish carpenters. They may install, replace and repair wooden flooring in public buildings and private homes. The flooring might be installed over existing floors or sub-floors, open joists or on a concrete slab. Wooden floor installers prepare the surfaces to be covered in addition to performing the actual installation. They calculate surface areas, measure, mark, cut materials and use hand and power tools. An accurate sense of measurement and alignment is required. Brute physical strength is not necessary but stamina is required in order to stoop, crawl, squat, lift and stand for hours at a time. A high degree of skill must be developed in order to perform some of the installation processes such as the intricate laying of parquetry. The wooden floor installer must also be willing to be mobile, for there is seldom work available on a particular construction site for extended lengths of time.

MATERIALS

Both hardwoods and softwoods are used in interior flooring, but hardwoods are used far more extensively. The hardwoods most used are oak, maple, beech, birch and pecan. Oak is used in almost 80 percent of the residential wood flooring in the United States. Softwood flooring — pine, fir, spruce and cedar — is used for some extent in more economical structures.

WOOD FLOORING

Wood flooring is usually classified according to the method by which it is sawn. Quarter sawing permits the edge grain to be exposed as the floor surface; plain sawed flooring exposes the flat grain.

Hardwood strip flooring is manufactured in a variety of thicknesses, from 5/16 to 15/16 inch. The standard thicknesses of strip

flooring are 3/8, 1/2 and 25/32 inches. Of these the 25/32 inch is the most commonly used. The widths can vary from 1 and 1/2 to 3 and 1/2 inches but four widths are most popular — 1 and 1/2, 2, 2 and 1/4 and 3 and 1/4 inches. All hardwood flooring comes in bundles of random lengths. No pieces under 9 inches are included.

To prevent warping and to ensure smooth installation, all wood flooring is kiln dried. Before finishing, the moisture content of flooring is crucial. Never attempt to install flooring in a room when the humidity is high, (as when there is "fresh" masonry work nearby).

BLOCK AND PARQUET FLOORING

Block and parquet flooring is available in all of the regular flooring hardwoods. As in strip flooring, oak is the most often used wood. Block and parquet flooring is manufactured in a number of sizes, the most common of which is 9 x 9 inch squares and is divided into two major types, unit blocks and laminated blocks. Laminated blocks lend themselves to a greater variety of surface designs, but are usually more expensive. When installing unit or solid blocks, care must be taken to allow for expansion. Both types of blocks can be laid diagonally, squarely or in any number of interesting patterns.

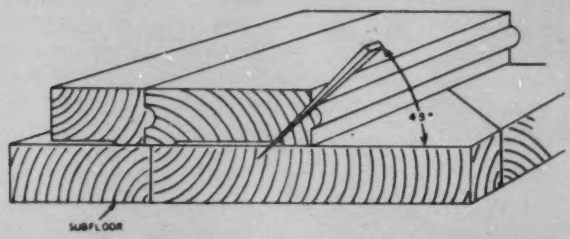
The standards by which hardwoods are graded vary according to the way it is cut, the kind of wood and the manner in which it is processed. Furthermore, grades may be mixed and terminology applied in one area that cannot be used in another. The full grading information is complex and detailed.

STRIP FLOORING

Strip flooring is tongue and grooved and may be applied directly to wooden sub-floors, to screeds (sleepers) attached to a concrete slab, or to furring strips laid on a wooden sub-floor. When applying strip flooring directly to a sub-floor, it is best to position it at right angles to the joists. Screeds may be layed several different ways. They may be on 24- to 36-inch centers, with ends overlapping at least four inches. They are attached to the slab by a suitable mastic. They may also be laid as continuous pieces on 16-inch centers. A sub-floor may be installed on these sleepers or the finished hardwood floor may be applied directly to them. In any of these operations, steps must be taken to seal out moisture by using a suitable moisture barrier. In some cases, Federal Housing Administration specifications must be observed. It is then necessary to check with local F.H.A. authorities.

Before actual flooring operations begin, the structure should be completely enclosed, all plaster and cement work completed and thoroughly dry and a minimum temperature of 70 degrees maintained in the building for at least four or five days before installation.

The first course of tongue and groove strip flooring should be laid with the grooved edge parallel and about an inch away from the longest wall. This one-inch space will be covered later by the



baseboard and shoe molding in combination, but will allow expansion room for the flooring. In new construction, strip flooring is laid parallel to the longest dimension of the structure. This permits the flooring to run across joist and to run continuously from one room to another throughout the building. The shorter strips should be used in closets and general flooring areas — not in doorways, room entrances or any other area subjected to heavy wear.

The grooved edge of the first piece is face-nailed with the nails positioned so that they will later be covered by the shoe molding. The tongue edge is then blind-nailed at about a 50 degree angle. At the point where the tongue meets the shoulder, each nail is countersunk with a nail set. After the first course is nailed, each succeeding piece is blind-nailed on the tongue side only. All nails should be countersunk.

Care must be taken in the spacing and location of end joints of strip flooring. The end joints should be staggered to avoid having several of them grouped closely together. They should never be adjacent to one another, or be directly over end joints of the sub-flooring.

Do not attempt to set each strip of flooring into its final "tight" position as it is laid. After laying three or four strips, place a piece of straight edged hardwood against the tongue of the outside pieces and drive the pieces up snugly. Repeat after each three or four strips have been laid. Once the entire floor has been laid, install the shoe molding by nailing it to the baseboard.

GENERAL RULES FOR LAYING FLOORING

Block and parquet hardwood flooring can be installed on subfloors or concrete slabs. There are many kinds, types and styles of this flooring, and some have particular recommendations for their application. We suggest that you use the installation details for the particular product being applied. The following, however, are some general rules which apply in most cases.

When a wooden subfloor is to be used, the blocks or individual pieces of parquet may be either nailed or set in mastic. Nailing should be at an angle and through the tongue, as in strip flooring. When mastic is used, a thin coat should be applied to the subfloor which must be smooth, clean and dry. A layer of thirty-pound, asphalt-saturated felt is applied and another layer of mastic is applied. The flooring is then set into this.

When this type of flooring is to be applied on a concrete slab the mastic method must be used.

Block flooring is manufactured in two basic types, unit blocks and laminated blocks. Laminated blocks are made of three or more plys of hardwood bonded together with moisture-resistant glue so that the tongues are on opposite sides. Unit blocks are composed of a number of solid lengths of flooring with their tongues at right angles to one another. Both types are applied in similar fashion, with one exception: Expansion room must be allowed when unit blocks are used; laminated blocks do not require expansion room.

These blocks may be laid in a number of ways to form interesting patterns. All, however, are formed on a square or diagonal base. The flooring is ordinarily laid from the room center, (found by using a chalk line) outward to the walls.

Single strip flooring is available in a variety of woods and is used for laying herringbone, square and rectangular patterns. It is applied in a manner similar to blocks.

SAFETY CONSIDERATIONS

The General Safety Considerations section at the end of this manual covers most of the safety hazards and precautions that are applicable to flooring operations.

There are a few specifics which should be kept in mind, however. Care should be taken to provide adequate ventilation where mastics or adhesives are being used. A face mask should be worn over the nose and mouth to protect against dust while using belt

sanders. When working on joists over an open cellar there is always the danger of falling or of dropping tools or materials on workers below and adequate precautions should certainly be taken in this type of situation.

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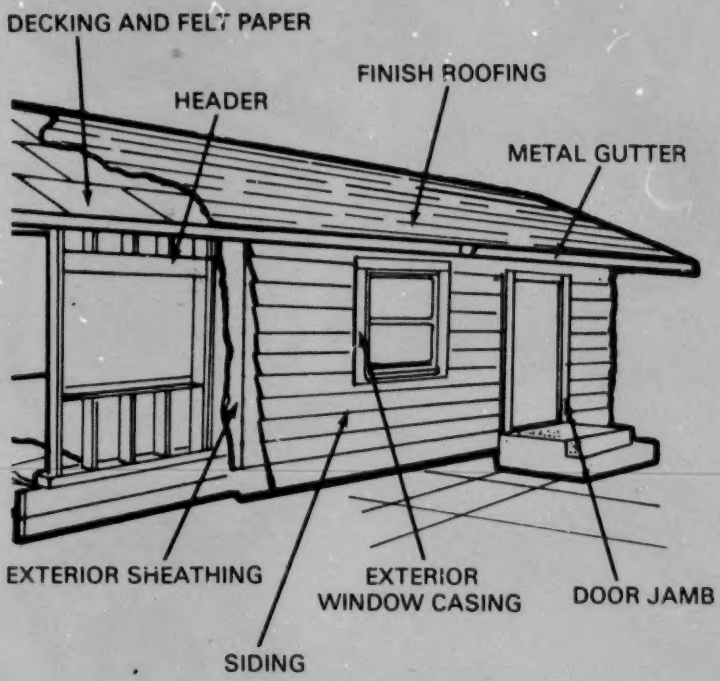

DECKING AND FELT PAPER
FINISH ROOFING
HEADER
METAL GUTTER
EXTERIOR SHEATHING
EXTERIOR
WINDOW CASING
DOOR JAMB
SIDING

43

TRIM CARPENTRY

A trim or finish carpenter is usually a carpenter with considerable experience. The forming carpenter's work is torn away after the concrete cures, and the framing carpenter's work is covered by the roofers and finishers, but the trim or finish carpenter's work remains exposed for all to see. Today they are aided tremendously by technology and specialized machinery. In most construction today, for example, the trim carpenter is not called upon to build door jambs and hang doors. Today most are delivered to the site prehung, ready to secure in waiting frames. The same is true of windows and cabinets. Although finish carpenters are aided by technology, they are also challenged by it. They continually have to work with new products and methods of application.

MATERIALS USED

A broad and constantly growing range of materials is used in the trimming or finishing of buildings today. Wood is used extensively, but there is an ever-increasing use of plastics, metals and synthetics both independently and in combination with wood and wood products.

Various forms of millwork are used throughout most types of wooden structures. Wood lends itself well to this purpose, for it is available in many styles and designs and can be painted, stained or otherwise treated to create almost any decorative effect. Because it is versatile and economical, trims and moldings are more often made of wood than any other material. Manufacturers produce this millwork in an almost unlimited number of sizes and designs. One manufacturer lists over 1,000 different moldings and trims. The following is a list of only the more popular kinds of moldings and trims. Each of these are available in a variety of sizes and designs.

- *Casing* provides a decorative trim around doors, windows and other openings.
- *Casing and Base* may be used as casing or as baseboard where the wall meets the floor.
- *Bands and black bands* are used in place of corner guards where only one edge is exposed, as with wainscot. They also make good shelf cleats.
- *Stops* are used to keep doors and window sashes in place.
- *Astragals* are used to cover the opening between French doors and sliding doors.

- *Picture molding* is installed horizontally along walls near the ceiling, and as the name implies, is used for hanging pictures.
- *Mullion casing* is used as a decorative trim between windows in a series.
- *Drip cap* is installed over exterior doors and windows to prevent moisture from seeping inside.
- *Corner guard* is used to cover interior or exterior "outside" corners.
- *Bed, cove and crown mold* are used to cover interior or exterior "inside" corners to provide a neat and decorative intersection.
- *Brick mold and cap* are caps that top off wainscots and horizontal bases. Brick molding provides neat trim where brick or stone meets wood in exterior walls.
- *Quarter round* is used in the same manner as bed, cove and crown mold.
- *Half round* is used in decorative trimming.
- *Base shoe* is used as a trim where the floor meets the baseboard.
- *Screen mold* is used for trimming wire or nylon mesh screens.
- *Rounds* may be used decoratively and as clothes poles in closets.
- *Glass beads* are used to secure a glass pane in a sash or frame.

Plywoods may be used extensively by the trim carpenter in the building of cabinets, shelving and other built-ins. Plywood can be made of either softwoods or hardwoods and is divided into two basic types, interior and exterior. Exterior and interior plywoods differ primarily according to the water resistance of their adhesives. Exterior plywood can withstand considerably more exposure to the elements.

Softwood plywoods use a system of letters to designate the quality of one side of each sheet. Briefly, these are:

N-Special order natural finish. Free of open defects.

A-Smooth and paintable. Neatly made repairs permissible.

B-Solid surface veneer. Circular repair plugs and tight knots permitted.

C-Knotholes to 1 inch permitted with occasional knotholes 1/2 inch larger. Has a specified limit of these defects per sheet.

D-Permits knots and knotholes to 2-1/2 inches in width and 1/2 inch larger under certain specified limits. Limited splits permitted.

The standard size of plywood is 4 feet x 8 feet, and it is available in thicknesses varying from 3/16 inch to 1 inch.

Hardboards and particle boards are used extensively in modern construction for siding, interior wall surfaces and cabinet work. These are manufactured by a number of different companies under various names. Particle board is made of wood chips and shavings pressed and bonded together with adhesives. It is used extensively as a base for plastic laminates and as a core for plywood.

Hardboards are made from refined wood fibers pressed together to form a hard and durable material. They are available in various textures and finishes and are used in a variety of ways.

Plastic laminates are also being used more extensively than ever before. These are available in various degrees of quality, and the better ones form a surface finish that is extremely hard and durable. They are available in an almost unlimited number of colors, patterns and textures.

SIDING

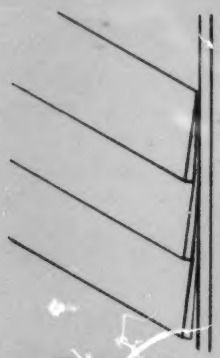
Exterior wall covering, or siding, is made of various types of material. The type of siding used often determines who does the installation. Roofers sometimes apply aluminum or shingle type siding. Some siding is of a particular material that requires a specialist for correct application. Many types of wooden siding, however, are applied either by a general carpenter or a finish carpenter.

Most wooden siding is made of white pine, fir, cypress, cedar or California redwood.

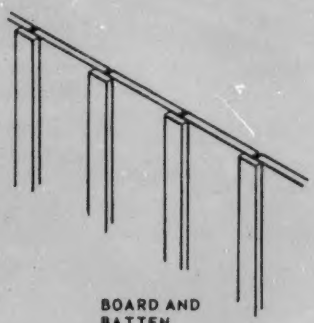
- *Bevel siding* consists of boards resawn at an angle to produce a siding plank with the top edge 3/16 to 1/2 inch in thickness and the bottom edge 3/8 to 3/4 inch. Common widths are 4, 5, 6, 8 and 10 inches. Most siding comes in bundles from 4 to 16 feet in length. Bevel siding is usually applied on wood sheathing with its thick edge overlapping the next board's narrow edge.
- *Colonial siding* is siding applied in an overlapping manner. It is similar to bevel siding except that it is usually wider and is not beveled.
- *Drop siding* is usually a full 3/4 inch thick and is commonly applied directly to the studs. It is matched at the upper and lower edges either by a tongue and groove or shiplap. This method is

also used when applying large waterproofed sheets of decorative plywood.

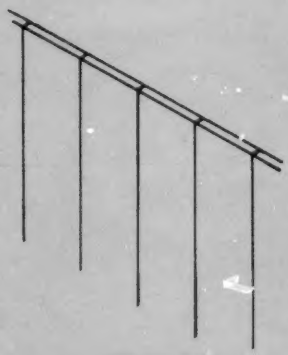
- *Shingle siding* of many different materials is available as exterior siding. Composition, asbestos, aluminum, various kinds of woods and plastics are the more common kinds. All shingles should be applied either to sheathing or horizontal strips, properly spaced and nailed to the studs.
- *Composition siding* varies greatly from one manufacturer to another, both in form and method of application. One should always refer to the manufacturer's recommendations when applying composition siding.



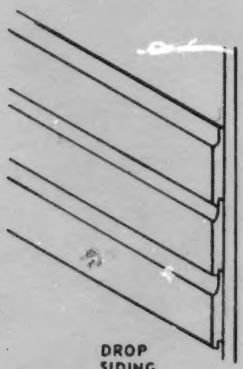
BEVEL SIDING



BOARD AND BATTEN



TONGUE AND GROOVE BOARDS



DROP SIDING

REVIEW OF PROCESSES

In order to understand and appreciate trim carpentry and its opportunities for employment, it becomes necessary to consider the various processes which are involved. The following is a necessarily brief examination of the more important processes.

APPLY VARIOUS TYPES OF SIDING

The trim carpenter may be required to install any of a large selection of wood, asbestos, metal, asphalt or plastic types of siding.

Wooden siding is designed to be applied vertically or horizontally and may have a natural finish or require painting. Vertical siding may be either tongue and groove, lap and gap or utilize batten boards to cover the cracks. It is available in regular or random widths. Application of either type requires careful measurements, close tolerance in cutting and extreme care in nailing. Wooden siding is adaptable for new construction or remodeling purposes.

Asbestos cement siding is generally used for low cost construction. All asbestos shingles are applied horizontally and require considerable insulation on the frame work. This type of shingle is very brittle and is subject to breakage from hailstones or rocks. It has excellent fireproof capabilities, however, and requires very little maintenance.

Aluminum siding has enjoyed much popularity over the last twenty years, although the demand for it appears to be lessening now. It was and still is used extensively for remodeling home exteriors. It is styled primarily for a horizontal application that gives a clap board, beveled, or rabbited siding appearance. Aluminum siding requires very little maintenance because it is prepainted. It is subject to dents, however, if struck by falling limbs or rocks.

Asphalt shingles and asphalt roll-type siding are used on very inexpensive housing. The application of this type of siding is rarely done by trim carpenters because it is a roofing procedure.

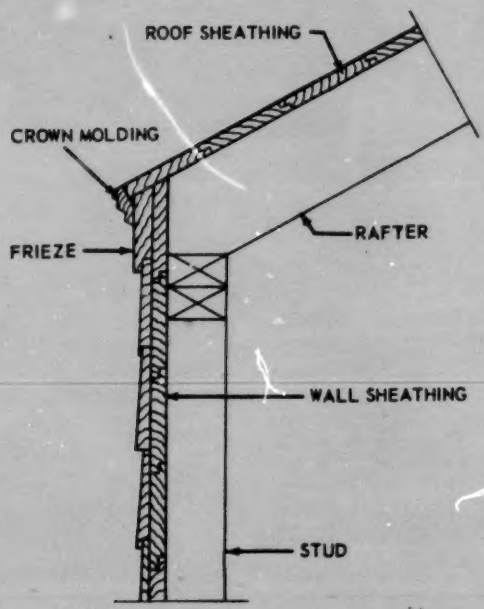
Available on the market in an ever-increasing volume are plastic type sidings. The most popular now is actually a tempered hardboard, covered with a design that may give the brick, wood or shingle appearance. It usually is available in 4 x 8 foot sheets that are nailed to the exterior of the structure.

BUILD VARIOUS KINDS OF CORNICES

Cornices are built in three distinct styles. For many years the open style allowed plain rafters to be exposed under the eaves. Frieze boards were simply installed to seal off the area between the rafters. Generally speaking, open style today refers to the exposure of heavy, rough rafter beams with a sawed design on the ends.

Frieze boards are still used to finish the area between beams and are of the same finish. Bed and rake moldings are used to corner in between the frieze and deck.

Closed cornices are quite popular because they have very minimum maintenance requirements. However, much more labor and material are required for their installation. Nailing blocks, called lookouts and lookout ledgers, must be installed first. These must be carefully leveled. Soffit boards are installed with vent holes, and ultimately vent covers are put in place. The fascia covers the rafter ends and overhangs the soffit far enough to allow quarter round molding between the soffit and fascia overhang. Frieze boards are installed against the wall and soffit, while bed and rake



molds finish the corners of the soffit and frieze boards. A closed cornice requires a rather complicated return on the corners of the structure where a gable starts.

A simple cornice is built when a structure has no overhang. This style was popular for many years in residential housing, but now it has yielded to the wide overhang, both for weather protection and aesthetics. The simple cornice requires that the fascia, frieze and the bed and rake molds finish the rafter ends.

BUILD WINDOW FRAMES

The practice of building window frames on the job is virtually nonexistent where this product is readily available from local wood mills. To construct a window frame requires extensive morticing and dado work. Mills are set up for the production of these items, making it economically unfeasible for the trim carpenter to do this on the job site. It should be mentioned also that the aluminum window is being used to such a great extent now that it is rare to find specifications calling for the installation of wooden frames and windows.

ASSEMBLE AND INSTALL WINDOW FRAMES

As was previously mentioned, the aluminum window has virtually replaced the wooden style. Unlike its wooden counterpart, metal windows do not require painting and are not subject to warpage. But, regardless of whether the specifications call for wood or metal, there are assembling, weather proofing and careful measuring, leveling and shimming activities that must be adhered to. Wooden window frames must be assembled and trimmed to fit the opening. Finish or casing nails must be used on any surface of the frame that will be exposed to view. Usually metal windows are delivered to the job site completely assembled and ready for installation. For frame structures the metal window is usually installed with wooden screws using the same precautions of squaring and leveling that is performed in wooden frames.

BUILD AND INSTALL DOOR FRAMES

Like window frames, doors and frame units may be purchased completely assembled except for the casings on one side. However, when necessary it is possible to build a door frame on the job site because of the simplicity of their construction. Door

frames consist of a three-piece jamb and a three-piece casing. The best frames, however, house the head jamb into grooves dadoed into the side jambs. This procedure is unlikely to take place on the job site.

Whether the frames are built on the job, delivered knocked down, or delivered completely assembled, important activities include leveling, squaring, shimming and nailing the frame into place with finish nails.

APPLY PORCH TRIM

Porches or verandas which protect and enhance the beauty of a front entrance have roof supporting beams and/or rafters that, due to the grade of lumber used, must often be clad in various finish lumber and molding products. Beams that support the rafters are covered with beam casings on each side, while a soffit board covers the lower side of the beam. Exterior to the beam, where the casing meets the roof deck, a crown molding is usually installed. This molding may match the bed and rake molding that is used under the eaves. A porch ceiling is installed if exposed rafters are not desired. In this case, molding must be installed in all upper corners where the porch ceiling meets the walls and the beam casing.

Decorative turned spindles for support columns and smaller scale spindles and hand rails may be used in the porch area to add to the decor. Or, for the rustic look, rough sawed cedar columns may be used for support and hand rails made of wrought iron used to finish out the style.

BUILD FRONT ENTRANCES

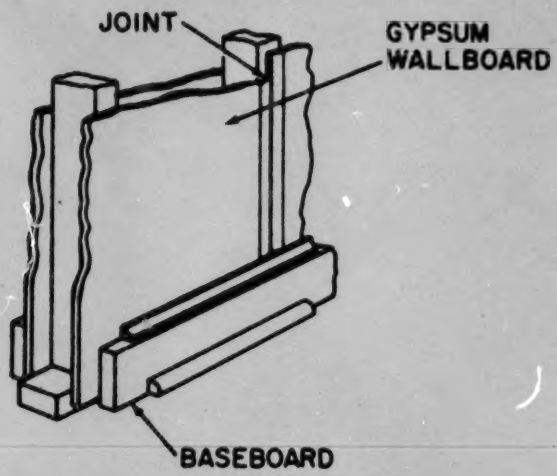
An entrance is usually built at a wood mill and delivered to the job in knocked down condition. The trim carpenter checks for any discrepancies in dimensions and style and then proceeds to install it. Ornate entrances generally have pillisters, pillister bases and caps and an entrance head. These parts are non-functional and are placed after the door frame has been installed, covering the functional casing from view.

FIT AND HANG DIFFERENT KINDS OF WINDOW SASHES

The trim carpenter of 25 years ago fitted and hung window sashes just as he built frames and installed belt courses. Now this procedure is antiquated because sashes are installed at a wood mill, just as metal sashes are installed at the assembly plant where metal windows are manufactured.

APPLY WALLBOARD AND PANELING

Because of its versatility and relatively easy installation, gypsum wallboard is used extensively. Wallboard is readily available in thicknesses of 3/8 to 1/2 inch in 4 x 8 foot sheets. Other thicknesses and greater sheet lengths may be obtained through special ordering. Standard 4 x 8 foot gypsum board is nailed to studs and rafters placed on 16 inch centers so that the ends of the sheet terminate in the middle of a framing stud or rafter. The sheet rock nails are placed at least every six inches and are driven to a point where the heads are at least 1/16 inch below the surface.



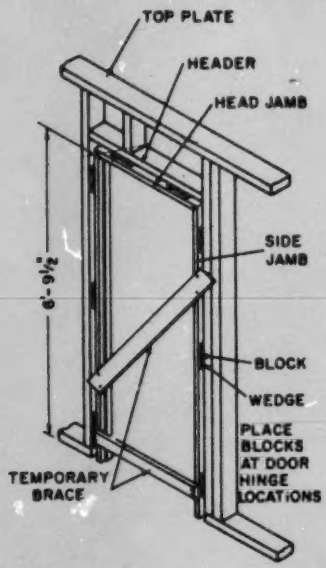
Two staggered courses of horizontal gypsum wall board will cover most wall areas. Holes must be cut for receptacles, switches and lighting fixtures, and trim work is done around window and door openings. In taping and floating, all joints are covered with a layer of plaster. While the plaster is still wet, perforated plaster tape is embedded in the plaster. After this has been allowed to dry, another layer of plaster is spread with a wide trowel. After this layer has dried, additional plaster work or sanding operations may be performed.

Virtually all paneling is designed to be installed vertically. As in the application of gypsum wallboard, the frame studs must be placed 16 inches O. C. (on center). Paneling may either be nailed in place or installed with adhesives. A paneling job is always started in a corner of the room. The corner is checked and if it is not plumb, the panel board may have to be trimmed. If molding is not going to be used, the corners may be scribed for a perfect fit.

Nails should be applied every 12 inches along the studs and every six inches around the outer edges. If adhesive is used, it is applied to every stud in which the panel comes in contact. Nails at the top hold the panel up when an adhesive is used. Subsequent pieces are applied, and great care in measuring is taken when the pieces are cut for receptacles, switches and doors. Also, the face side of the panel is vulnerable to scratches, so it should be protected from tools and rough work surfaces.

FIT AND INSTALL DOOR CASINGS

There are four types of trim procedures used on door and window casings: The simple square-cut, corner-block, backhand and miter. Of the four the miter and simple square-cut trims are the most popular among present day contractors and architects. The miter simply requires that the joint between the side casings and head casing be cut on a 45 degree angle. The simple square-cut allows the head casing to span the complete distance across the

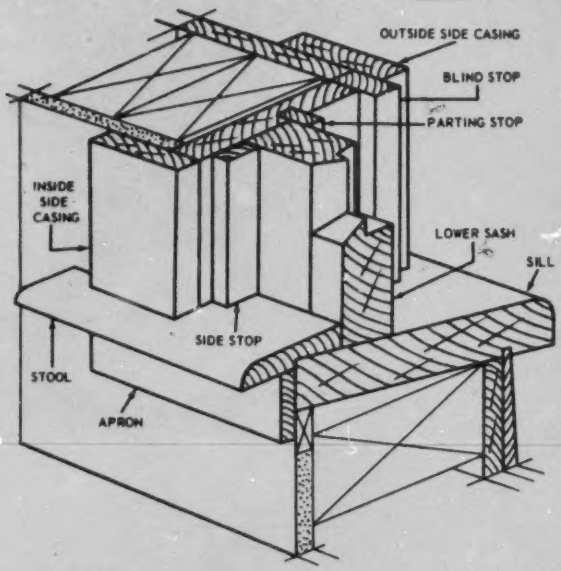


tops of the side casings while the side casings butt with a finished joint beneath the head casing. In either procedure, it is necessary to make careful measurements from the floor to head jamb and the frame opening at the head jamb in order to determine the lengths of the casings. It is often required that the casings be recessed 1/4 inch, in which case allowance of an extra 1/2 inch on the head casing and 1/4 inch on the side casings is made. The

measurements are transferred to the casing stock and the cuts (90° or 45°) are made in a miter box with a back saw. The casings are positioned one at a time, (usually a side casing, the head, then the other side) and nailed into the frame with finish nails. The nails must be countersunk and puttied.

FIT AND INSTALL WINDOW TRIM

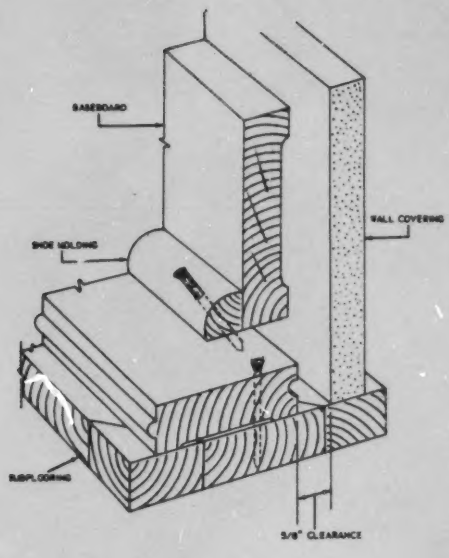
Fitting and installing window trim is an identical procedure to that of door trim, except that the recess between the edge of the jamb and casing is omitted and the window stool and apron are installed. The stool has an angle groove on the under side that



conforms to the angle of the window sill. The stool is nailed in place first, and under it, the apron. The side casings go on next, followed by the head casing. As on door trim, the joint style between the casings may be mitered, simple, block or backhand. Finish nails are used in all installations.

INSTALL BASEBOARDS

The trim board that is placed against the wall on top of the finished floor is called a baseboard. Another molding, called the base shoe, may be placed on the floor against the baseboard. It is usually milled from hard wood so that it may stand the abuse of furniture and cleaning. Baseboard is often rounded or styled on its



upper edge. If not, a "base-cap" molding can be placed on top of the baseboard. All joints may be mitered to give a superior finish appearance. As in the other trim work, the baseboards and molding must be nailed with finish or casing nails.

It should be mentioned that there has been a trend to exclude the installation of baseboards. Floor covering people have made it possible to fit coverings such as carpet to the wall. The disadvantage of this is the possibility of scarring the wall while cleaning.

INSTALL CEILING TRIM AND WALL TRIM

There are a number of types and shapes of ceiling trim. Two-piece, dentil cornice molding is an elaborate style available. Picture and cove molds are also frequently used. The installation of ceiling trim requires miter joints exclusively and finish nailing.

Present day planners, however, in seeking economy of construction and future maintenance, have sought to eliminate such decoration, particularly in homes where the rooms are completely sheetrocked.

Wall trim may include chair rail molding that is applied at a height to prevent chair backs from scarring the wall. Panel molding is a rather old-fashioned type used to divide wall space into panels.

Inside and outside corners are often trimmed in quarter round molding and corner molding respectively.

It must be emphasized that the selection of trim materials should include considerable pre-planning in order to create uniformity of style and design.

BUILD AND INSTALL KITCHEN AND BATH CABINETS

Building cabinets on the job site has almost become a thing of the past because of the availability of pre-fabricated cabinets in virtually any size and style. However, the trim carpenter does exercise skill in installing cabinets that are plumb and level, secure and faithful to the contractor's specifications.

Rarely will the angle of two walls or a floor and wall be absolutely square. The preliminaries of installing a cabinet include placing it in position, checking the plumb and level, and then securing the bottom of the cabinet to conform to the angle of the wall and floor. The same procedure is used in fitting the side of the cabinet to the wall. (Cabinets are built with an excess of material on the ends for this purpose.) The cabinet is toenailed into the floor and wall studs when it is absolutely certain that the cabinet is in the correct position and is plumb and level. Similar procedures are used for installing upper cabinets, excepting for corrections made to the bottom.

INSTALL PLASTIC LAMINATES

Plastic laminates are a widely used product for both commercial and residential applications. It is an extremely durable material for counter, cabinet and table tops. It is fairly easy to apply and requires very little maintenance.

In preparing for installation, metal trim molding is nailed to the surface where required. The surface is carefully measured and, if irregular shapes are involved, templates are made. The laminate is cut to conform to the surface leaving a small excess to overhang.

The laminate is adhered to the surface with contact cement which is spread evenly on both surfaces and allowed to set to a point where it does not stick to your fingers. The piece is carefully set in place using wrapping paper to keep the surface and the laminate from making contact. When it is certain that the laminate is in the correct position, the wrapping paper is withdrawn and the two surfaces are brought into contact. A heavy roller may be applied to all points to ensure bonding. Edging may be applied in the same manner, making sure that the edging and the top laminate are in direct contact. A router, with a special edging tool, may be used to finish all corners. This may also be done with a smooth file.

BUILD INTERIORS OF CLOTHES/LINEN CLOSETS

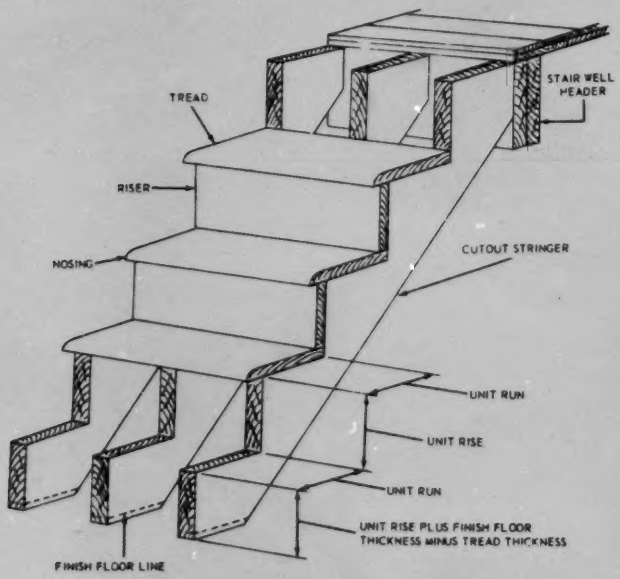
Interior trim work on closets may utilize gypsum board or cedar lining. Procedures for gypsum dry board installation in a closet is really no different than in any other area of a house. Cedar has long been noted for its insect repellant characteristic and pleasant odor.

The tongue and groove, aromatic cedar that is used for closet lining is usually applied on a base material such as plywood because of its thinness. It may be toenailed either vertically or horizontally. All areas, including the ceiling, may be covered with this material, although wall application provides ample protection.

Linen closets are often drawer-type, in which case the cabinet with drawers is purchased from a manufacturer. If specifications call for the door-type linen closet, these may also be purchased.

BUILD FINISH STAIRS AND HANDRAILS

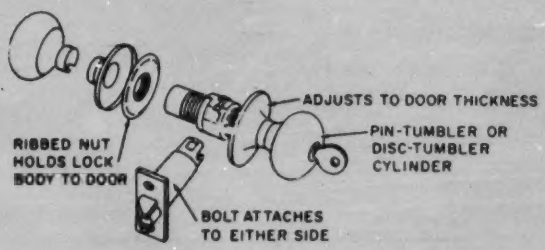
Finish stair construction is a special field of carpentry, and often the stairs are purchased from the mill in disassembled form. The trim carpenter's job is to check for mistakes and assemble the stairway. Trim carpenters are expected, however, to be able to construct other less important exterior, basement and porch stairs.



It is important to be aware of structural safety precautions for future users of the stairway. Consideration should be made of tread and riser dimensions, nosing size and handrail construction. Finally, the finish on the tread should be slip-proof. A data book on stair construction is a helpful aid at this stage of the process.

APPLY FINISH HARDWARE

Applying finish hardware involves installing drawer and cabinet door pulls, hinges, catches, door locks and striker plates and butt hinges. Various other metal, plastic and ceramic items throughout the house or building may be called for in the specifications. The more difficult installation of hardware for entry and passage doors will be briefly considered here.

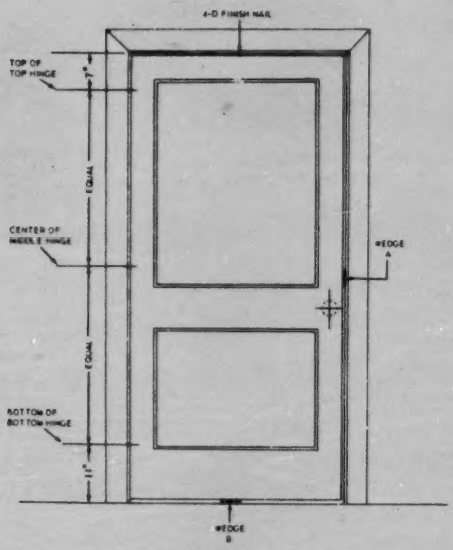


Door locks and passage knobs come from the manufacturer with explicit instructions and templates for hole drilling and mortising. Mortising requires extreme care in laying out the initial cutting lines. Before routers were in common use, the chisel was used almost exclusively to do the mortise work. Most trim carpenters now carry routers and templates that make fast work out of the mortising of the lock face and strike plate. Nevertheless, when a lock has to be installed into the door, drilling and chiseling must be done because most routers cannot reach the necessary depth. Electric drills are used to perforate for the lock spindle and key hole.

Butt hinges are presently being manufactured with rounded edges so that the mortise work done with the router conforms to the hinge.

INSTALL FOLDING, SLIDING AND HINGED DOORS

Folding, sliding, and hinged doors are all available in kit-form from the manufacturer. In the case of the hinged door, as previously mentioned, the door and frame may be delivered to the job site pre-hung in its frame.



The folding and sliding or pocket door is usually delivered to the job site disassembled with step by step instructions on how to install them. The procedure usually involves installing a track for both types. The pocket door must be installed before paneling is placed on the wall frame so that the track and other parts may be assembled.

Careful measuring and leveling procedures must be executed to ensure that the door closes properly. Nearly all hangers for pocket or sliding doors have adjustments for this purpose. Guides are placed at the bottom of the pocket door receptacle. Also, molding must be installed on the opposite jamb for recessing the door edge when closed. A sliding door will usually require the installation of a mortised pull, latch or lock.

Folding doors have a similar track installation with adjustable hangers. Passageway folding doors that are rigid do not require a bottom track. Many closet doors that are made of plastic materials do require a bottom track for stability. This type of folding door usually comes with latches or locks already installed.

SAFETY CONSIDERATIONS

Trim carpentry is not considered a particularly hazardous occupation. This does not mean, however, that serious accidents cannot happen.

There are times when a carpenter works with materials that are easily ignited, and since most of the material around him burns easily, fire safety must be kept in mind. Some adhesives such as those used to secure plastic laminates are highly volatile and explosive. Always follow manufacturer's recommendations when using such material. It is a good idea to keep a general purpose, dry chemical fire extinguisher on every job and be aware of its location.

A major hazard in trimming operations is the danger of drilling or nailing into electrical wires, air conditioning lines or water lines. Always be sure of the exact location of these lines or conduits before drilling or nailing into a wall.

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SAFETY

The forming of good safety habits and attitudes is as important as becoming skilled with the tools and procedures of carpentry. The ability to recognize conditions where danger may exist is probably the most important factor in maintaining safe working conditions. When dangers are recognized, they can be avoided. A work area cluttered with tools, lines and boards with protruding nails is often "an accident waiting to happen"—especially if the clutter is allowed to accumulate in walkways where material is being moved or on an upper level of a construction site. When a certain amount of clutter cannot be avoided, the worker must use extra caution. A neat working area with tools and materials available, but not in the way, is more efficient as well as being safe.

Ladders and scaffolding are useful, necessary equipment on most jobs, but they are also a source of many accidents. Ladders should basically be used for moving workers from one level to another. If it is absolutely necessary to work from a ladder or move anything by means of a ladder, extra precautions should be taken. All scaffolding should be erected by experienced people and inspected regularly. All safety lines and rails on scaffolding should be fully employed. Never take a chance on a ladder or scaffold that is a little "shakey."

The following are some general safety considerations regarding ladders:

1. They should be erected at the proper angle. The distance from the base of the ladder to the base of the work should be approximately 1/4 the length of the ladder.
2. A ladder is designed for one person at a time.
3. Never paint a wooden ladder. (Cracks cannot be detected.)
4. Do not climb a ladder while wearing wet or muddy shoes.
5. Secure the ladder so it will not blow down.
6. Face the ladder when climbing.
7. Never stand on the top rung of a ladder.
8. Place the ladder where work can be reached—never lean out far on one side.
9. The ends of the ladder should be firmly and evenly set against the ground and the work.

Portable power tools are widely used on most construction sites and can also be a source of accidents. One must be familiar with the dangers inherent in any particular tool being used. Always

make sure the stock is securely in place. Never use a power tool while standing on a wet surface unless the tool is specifically designed for that purpose. Use a three wire conductor and be sure the tool is properly grounded. Never lift or carry a power tool by the cord.

To maintain safe working conditions, a worker must be aware of others. Do not attempt to move large or awkward materials past someone who is using power machinery. Never turn on a breaker switch at a construction site until you have checked to see if anyone is working on the wiring. In general, simply be considerate of other workers and their safety, as well as your own.

Sometimes certain safety equipment or apparel is required of a worker by local codes or insurance regulations. If a worker does not use this equipment, insurance may not be collectable for loss due to a resulting accident. It is of utmost importance that the worker use safety devices when they are required and often when they are not. Steel-toed shoes, safety goggles and hardhats all serve a purpose and are required for a good reason. Use them.

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AFTER GRADUATION

GOING TO WORK

Regardless of the school courses you have had, in all probability your first job in carpentry will be as a helper or laborer. Your first job is bound to prove disappointing in some ways and enlightening in others, but most important you will have begun to develop the skills and knowledge necessary for reaching your goal of becoming a journeyman carpenter.

An individual's first job in carpentry is usually a time of considerable personal adjustment and adaptation. The work environment is quite different from the one at school. New workers on a job have more to do than just perform the assigned tasks; they must learn to give and take and get along with the "boss" and fellow workers. It is always up to new workers to fit into the scheme of things rather than the other way around.

An employer expects a number of things from all employees. It will be expected that you will be on time. The employer is not terribly interested in your flat tire or faulty clock story. The employer just wants you to report to work on time. You must also be reliable. During certain periods you may be expected to work more than a regular 40-hour week. During very cold or very warm

weather you may be quite uncomfortable on the job. Whatever the condition, an employer must be able to rely on you to be on the job. You will be expected to have certain equipment and clothes. On many jobs, steel toed shoes and hard hats are required. Carpenter's overalls are standard attire, but you should be prepared to dress according to the situation. You will also be expected to have your tools in good shape and have them available. On some jobs you may be expected to have and use a full set of tools; on other jobs you may need only a hammer, but whatever is expected you should make every effort to supply these tools.

Disappointments may occur often on your first job. You may be assigned menial tasks and begin to wonder if you wasted your time acquiring skills that you are not given a chance to use. When this occurs, try to remember that more than likely every person on the job has gone through exactly what you are going through and that it is not all without purpose. Some employers deliberately assign the most unpleasant, uncomfortable, least rewarding jobs to a new person to test attitudes. On the other hand, seniority will always have a certain amount of influence on who gets what job.

There are also rewarding and satisfying moments on the job. To be self-supporting and independent is one of the greatest satisfactions a person can have. To advance in the eyes of your fellow workers and be given compliments and pay increases is also very satisfying. As in any vocation, your ability to handle both rewards and disappointments will have much to do with your success or failure.

MORE EDUCATION

There are a number of possibilities for continuing your training and education in carpentry after high school. Among these are

union apprenticeship programs, government training facilities, (including military service) and technical or vocational junior colleges and trade schools.

Many training authorities, including the National Joint Carpentry Apprenticeship and Training Committee, recommend the completion of a 4-year apprenticeship program as the best way to learn carpentry. These programs are extremely thorough and well-rounded and usually result in especially favorable long-range job prospects.

Apprenticeship applicants are generally required to be from 17 through 27 years of age. A high school education or its equivalent is desirable. Good physical condition, a good sense of balance, and lack of fear in working on high structures are important assets. Aptitudes which the apprentice should have include manual dexterity and the ability to solve arithmetic problems quickly and accurately.

The apprenticeship program usually consists of 8,000 hours (4 years) of on-the-job training, in addition to a minimum of 144 hours of related classroom instruction each year. During the apprenticeship period, the apprentice learns elementary structural design, becomes familiar with the common systems of frame and concrete form construction and learns to use, care for and handle safely the tools, machines, equipment and materials of carpentry. The apprentice also learns how to lay out work, do rough framing, do outside and inside finishing work, (as hanging doors, setting and finishing windows, fitting hardware, and flooring and stair work), weld, perform acoustic and dry-wall construction and erect scaffolding and shoring.

The apprentice receives related classroom instruction in drafting and blueprint reading, mathematics applicable to layout work and the use of woodworking machines. Both in the classroom and on the job the relationship is learned between carpentry and the other building trades because the work of the carpenter is basic to the construction process.

Hourly wage rates for apprentices usually start at about 50 percent of the journeyman rate and increase by about 5 percent for each 6-month period, until a rate of 85 to 90 percent is reached during the last period of apprenticeship.

Another source of training in carpentry is through programs sponsored by the federal government. In recent years special training programs including the Job Corps, Neighborhood Youth Corps and Manpower Programs have been developed throughout the United States. Most of these programs are not only free, but pay the student while in training. Your school counselor or local state

employment service can provide details concerning the qualifications, availability and location of these programs.

The military services should not be overlooked as a source of further training. Training and experience in almost any given area of construction is offered by some phase of the military. Often the time spent in training in the military is accepted by unions, such as the United Brotherhood of Carpenters and Joiners of America, as apprenticeship experience. Your beginning wages would be adjusted according to the training received. The vocational training gained in the military often includes broad and varied experiences and it proves to be of considerable value.

Technical and vocational junior colleges and trade schools offer still another source of training after high school. Although this training is not a substitute for apprenticeship, credit for the training is sometimes permitted to shorten the apprenticeship period. Many of these schools offer specific building trade programs, as well as industrial art courses in woodworking and wood finishing. Some of the programs can lead to an associate degree in construction technology. Most of the programs last one or two years, are economically reasonable, and offer good opportunities for receiving related academic training.

TOOLS AND EQUIPMENT

Measure, Square and Layout

Builder's tape—A retractable steel measuring tape 50 or 100 feet long, also known as a tape rule or steel tape.

Chalk line—A string or cord saturated with chalk and kept in an enclosed reel or chalk box. It is used to snap or mark long straight lines.

Combination square—A metal square with an adjustable blade, spirit level, scribe and 45° and 90° angles.

Layout line—A heavy duty string or light cord used to lay out the lines of a building.

Sliding T Bevel—An adjustable try square with a slotted, beveled blade used for laying out angles other than right angles and for testing constructed angles such as bevels.

Try square—An instrument consisting of a thick wood or iron stock at right angles with a thin, steel blade used for setting or checking lines which must be at right angles with each other.

Framing square—A steel square usually 12 inches x 8 inches, 24 inches x 16 inches, or 24 inches x 18 inches. The flat sides of the blade and the tongue are graduated in inches and fractions of an inch, and information is engraved on the square which often eliminates the need for computations in framing operations.

Zig Zag rule—a folding, 6 ft. long wooden or metal ruler.

Push pull rule—a metal, retractable tape measure usually 6 to 12 ft. in length.

Measuring tape—a retractable, 50 to 100 ft., roll-type measuring tape.

Chalkline reel—a reel of twine contained in a box with a self chalklining device, used to snap long straight lines along decks, valleys, slabs, etc.

Steel square—usually a framing or carpenter square, primarily used for testing and checking trueness of an angle or for laying out lines on material.

Calipers—Pincer-like tools used to measure an object or surface such as a cylinder which would be difficult to measure by other means.

Marking gauge—An apparatus commonly made of wood, with a scribe set in one end and an adjustable ring on the other. Used for marking a line parallel to the edge of a board.

Cut

Asbestos cement siding and shingle cutters—A tool used for cutting both siding and roofing shingles.

Cross-cut saw—A saw used for cutting across the grain of wood. It differs from a rip saw primarily in the shape of its teeth and in its use.

Portable power circle saw—An electric powered, handheld saw used for the straight cutting of wood and other materials.

Rip saw—A straight back saw used for cutting *with* the grain of wood.

Router—A portable, electric powered tool for cutting and shaping material. It is used especially for cutting decorative moldings and edging.

Saber saw—(portable jig saw) An electric powered, reciprocating saw used for cutting scroll work.

Back saw—A cross cut hand saw with a rigidly reinforced back. It is used to cut absolutely straight lines across the face of a board.

Coping saw—A small bladed saw with a deep frame, designed for cutting curved designs in thin material.

Slip joint pliers—General purpose, adjustable pliers used for holding and cutting.

Cold chisel—Flat tools used for chipping or cutting metal or, in this case, roofing tiles.

Handsaws—Both crosscut and rip are used. A 26 inch blade is common. Crosscut saws are used for cutting across the grain; rip saws are used for cutting with the grain.

Hacksaw—A saw with interchangeable blades used to cut metal that is too heavy for snips or boltcutters.

Roofing knife—A hook-blade knife used to cut various roofing materials.

Roofer's hatchet—A specialized tool used by roofers to drive nails and cut and gauge roofing shingles.

Side cutting or diagonal cutting pliers—Used mostly for cutting tiles and tie wires.

Tile pincers—Also called nippers, used to cut or nip off chips of roofing tile.

Tile pick—A pick designed for cutting tile.

Drill and Bore

Auger bit—A device used in hand drills for boring holes.

Countersink bit—A bit designed to bore or cut a tapered hole in material for countersinking screw heads.

Expansive bit—An adjustable wood boring bit commonly used to bore holes 1 inch or larger in diameter.

Hand drill—A hand-powered tool used for boring small holes.

Portable power drill—An electric powered, hand-held drill used for boring operations.

Spiral hand drill—(push, pull ratchet drill or driver) A hand-held tool which spins or turns a drill bit or screw driver bit when pushed.

Twist drill—Spiral shaped, single-piece drill bits used for boring or drilling small holes. Can be used in either electric or manual drills.

Brace and Support

Tile stake—A special tool used to support tile while it is being shaped or cut with a pick.

Shinglers or roofers bracket—A metal bracket designed to hold a 2 x 4 or 2 x 6 to be used as a safe toe hold.

Adjustable ladder jack—Brackets which rest on the ladder rungs and rails. They may be adjusted to hold a cross member above or below the ladder.

Fasten

Pneumatic nailer—An automatic, compressed-air powered device used for setting nails.

Powder-actuated nailer—A nailer activated by a .22 or larger caliber cartridge.

Stapling hammer—Used to automatically staple felt to decking and in some cases used on composition shingles.

Pneumatic stapler—Used in the same manner as a stapling hammer, but is air powered.

Grind, File, Sanding

Belt sander—A portable electric tool using an abrasion belt to "sand" or smooth material.

Orbital sander [*finish sander*]—An electric powered sander used in finish work.

Planes—Are used for shaving, smoothing and shaping wood. The various kinds such as smoothing, jack, jointer and block are used for different operations.

Portable power planer—An electric powered rotary planer or jointer used for shaving, smoothing, fitting and shaping wood.

Apply

Flat trowel—Used for spreading adhesives or roofing compound.
Crack filler—A specially designed bucket with a small release valve on the bottom used to pour hot bitumen into cracks.

Sprinkler pot—A type of bucket used to "sprinkle" or pour bitumen by hand.

Mops—Both roller and plain mops, made of either cotton or fiber glass, are used to spread asphalt.

Caulking guns—Used to dispense roofing compound from a disposable cartridge.

Felt layers—A piece of equipment on wheels used to roll cut felt over a surface.

Gravel spreader—Either a hand operated or mechanically driven device used to spread gravel over roofs.

Brooms—Push brooms are used for spreading asphalt, mastic, gravel and other roofing materials, as well as for cleaning off surfaces to be roofed.

Other

Shingle and slate ripper—A device used for pulling nails and removing shingles or slate.
Slater's scrape—This is used to punch holes in slate and also to mark slate for cutting.

Dipper—A long handled dipper used for filling one bucket or container from another.

Carts—Various types of carts are specially designed to carry felt, bitumen and many other kinds of roofing materials.

Hoists—Used for lifting material and equipment to rooftops. Hoists may range from simple hand lines through ladder wheels to heavy wenches and equipment.

Spudding machines—An engine-driven machine for spudding or loosening old roofing or gravel.

Sledge—Heavy, double-faced steel hammers used to drive and set stakes, spikes, etc.

Ripping hammer—Very similar in appearance to regular claw hammers except that the claws are not curved. These straight claws can be used for splitting and ripping material as well as pulling nails.

Spudding bars—A manually operated tool with steel handles and heavy blades, used to loosen old roofs.

Spades—Used primarily for light spudding or removing composition shingles.

Scoup shovel—Used for removing some types of roofing and for moving and hand spreading gravel.

Kettle—Used for heating and melting asphalt. Most are fired by kerosene under pressure or by LP gas.

Claw hammer—The standard carpenter's hammer, generally with a curved claw, bell faced and wooden handle, used for driving and pulling nails.

C-Clamp—A screw type clamp, shaped like the letter "C".

Flooring nailer—A hand-held apparatus used for driving and setting specially designed nails into hardwood flooring at the proper angle and position.

Grooved trowel—A trowel with serrated edges used to apply and spread adhesive.

Mallet—A short-handled tool used to drive wooden-handled chisels, gauges and wooden pins, or to form or shape sheet metal where hardfaced hammers would mar the finished work.

Nail set—A blunt-ended, metal tool used for countersinking nails. It is available in several sizes.

GLOSSARY

A-frame—a portable frame built in the shape of the letter "A". Lines are rigged through a pully at the top of the frame for hoisting or lowering materials. It can also refer to a type of residential construction.

Abutment—the solid portion of a wall or pier which acts as a structural support.

Acoustical materials—special fiberous plasters, tile, wallboards, etc., applied to walls and ceilings to control sound.

Adhesive—mastic or glue used to secure ceiling, tile, wallboard, floors, etc.

Aggregate—inert materials such as sand and gravel primarily used in the making of concrete.

Air-dried lumber—lumber dried and cured in open air without the aid of artificial heat.

Aluminum molding—pressed or extruding strips of aluminum, available in a variety of patterns.

Aluminum nails—nails made of aluminum and used when an erosion and weather-proof wall is needed.

Aluminum siding—a pre-painted siding material made of aluminum.

Anchor bolts—metal bolts embedded in the concrete to which the structural members are secured.

Apex—the highest point or tip of a roof.

Appliances—apparatus or devices used in the home, such as stoves, refrigerators, washers, toasters, etc.

Apron—material which by shape or function resembles an apron, e.g., the horizontal trim at the base of a window.

Arch—the curved top of any opening.

Areaway—an open space around a basement, window or opening.

Asbestos—a highly fire resistant, fibrous material used for making roofing and siding.

Asbestos sheathing—a fire proof material high in insulating qualities used for sheathing.

Asbestos shingles—shingles made of cement and asbestos.

Asphalt—a petroleum product used in many forms of insulation and waterproofing.

Attic—the open space between the ceiling and roof.

Backfill—the replacement of soil after excavation.

Backhand—trim used on the side of a window or door casing for decorative purposes.

Backing—lumber placed behind or between other members to give strength and support.

Backmopping—to mop asphalt on the back or underside of roofing.

Balloon framing—a type of house framing where the studs are continuous through the second story of the building.

Balusters—small columns or spindles between the bottom and top rails of a stairway or balcony.

Baseboard—a flat, horizontal member, often decorative, placed along the floor line.

Basement—the base story of a house, usually underground.

Base sheet—the first layer of roofing applied to a deck.

Base shoe—a small, decorative strip which provides a finish at the junction of a baseboard and the floor.

Batten—narrow strips of wood used to cover butt joints of various material.

Batter—the slope or slant from the vertical of a wall or other structure.

Batter board—a temporary framework used to lay out a foundation.

Bay—any projecting part of a building in the form of an arc or polygon.

Bay window—a window in a bay.

Beam—the principal, horizontal members of a building.

Bearing—the point of support on a wall-structural member.

Bearing partition—a partition which supports any vertical load above its own weight.

Bed molding—a molding used to cover a joint of two surfaces meeting at an angle.

Bench mark—a mark on a permanent object from which land measurements are made.

Bevel—any side of a solid member cut at any angle other than 90 degrees is considered to be beveled.

Bevel siding—wedge-shaped, finish siding used on the exterior of houses.

Bind—to cause to adhere or stick.

Bitumen—asphalt or coal tar pitch.

Bleeding—the oozing or draining of saturant from roofing, paint or lumber.

Blemish—any defect, scar or mark that tends to detract from the overall finish.

Blind nailed—a method of nailing at an angle on the side of a board so that the placement of the next board will cover the head of the nail.

Blind stop—a rectangular molding usually 3/4 x 1 3/4 used in the construction of windows.

Blister—an air pocket, bubble or separation of layers of roofing.

Block flooring—a type of hardwood flooring in which the sections are square.

Board feet—the unit by which lumber is sold. It is normally computed 1" x 12" x 12" = 1 board foot.

Bond—to stick or fasten together.

Boxed stairs—stairs between two walls, with neither side open.

Box nail—similar to, but lighter than, a common nail.

Box sill—a header secured on the ends of joists and resting on a wall plate.

Brick ledge—a ledge of concrete, protruding from a wall on which bricks are to be laid.

Brick veneer construction—a type of construction in which a wood-frame house has an exterior of brick.

Bridging—the reinforcing or stiffening of joists by nailing braces between them.

Buckle—crumples or curls in roofing.

Building paper—commonly called felt, a sheeting of asphalt-saturated felt suitable for insulating for noise, heat and moisture.

Built-ins—may apply to appliances or fixtures such as book shelves which are built into the building.

Built-up roof—a roof formed by a number of layers of roofing supported with hot asphalt.

Butter—to smooth on mastic, concrete or other plastic materials with a trowel.

Butt hinge—a hinge designed to secure to the butt edge of a door.

Butt joint—two pieces of material fitted squarely against each other.

Camber—a slight arch in a horizontal beam which resists bending downward under pressure.

Canopy—a projecting or overhanging cover or roof.

Cantilever—a projecting beam supported only at an end.

Cap molding—an ornamental trim which may be used at the top of a window or door trim.

Cap sheet—the final covering of a roof.

Case—to put on casing or interior trim.

Casement windows—windows whose sashes hinge at the sides.

Casing—molding of various widths and thicknesses used to trim out windows and door openings.

Caulk—to plug or make watertight with mastic.

cement-coated nails—nails which are coated with a substance which substantially increases their holding power.

Check—a lengthwise separation or "crack" in wood.

Chicken ladder—a lightweight ladder used to hang over the ridge of steep roofs.

Cleat—a strip of wood or other material fastened across the face of some other material.

Closed cornice—a cornice that is completely enclosed by the roofing and fascia.

Closet pole—a round pole mounted horizontally in a closet on which clothes are hung.

Coating liquid—a liquid with an asphalt or coal tar base used to preserve roofs.

Collar beam—a horizontal beam secured above the lower ends of the rafters to add rigidity and support.

Column—any vertical, supporting pillar of wood, steel or other material.

Combination door—a door which can easily be changed from a screen door to a storm door by the changing of panels.

Combination window—windows designed in the same manner as combination doors.

Common—a grade of lumber.

Common nail—the flat-headed, wire nails most used in house framing.

Concealed gutter—a gutter or trough installed into the eaves in such a manner that it is invisible.

Condensation—the formation of droplets of water on a surface due to a contrast of temperature.

Conduit—a pipe or tube through which electrical services are connected.

Coping—the top covering of a wall.

Corner boards—boards used as trim on the exterior corners of buildings.

Corner braces—diagonal braces set into studs to reinforce corners.

Corner studs—two or three studs nailed together to form a corner.

Cornice—a horizontal trim around the roof line of a building.

Corrugated—roofing material shaped in alternating ridges and grooves.

Counter flashing—flashing which extends over other flashing.

Counter sink—to sink the head of a fastener below the surface of the material being fastened.

Course—a continuous single row or layer of brick, shingles, tile, etc.

Cove—a molding of a rounded internal angle, the opposite of bullnose.

Cripple—a short, supporting stud used under or over a header.

Cripple jack—a jack rafter running from a valley to a hip.

Crown—the upward bend in a bowed piece of material.

Cup escutcheon—a plate for use as a finger hold or latch on sliding doors or panels.

Cupola—a small structure which extends above the roof, usually for a decorative effect.

Cutback—asphalt dissolved into its liquid form.

Cutting bill—a list of dimensions for stock to be cut.

Dado—a rectangular groove in a board.

Dead load—the weight of permanent stationary construction.

Deck—the roof surface to be covered.

Diagonal—crossing obliquely from one corner to another.

Disappearing stair—a staircase which folds into an opening in the ceiling.

Door check or closer—a device which closes a door and prevents it from slamming.

Door jamb—the case surrounding the door.

Door pull—a handle or knob set which is used to grasp the door.

Door trim—the trim used to cover the opening between the jamb and the rough framing.

Dormer—the exterior or projection of building from a sloping roof.

Double acting butt—a butt hinge which allows the door to swing either way.

Downspout—tubing or pipe used to carry water downward from the roof.

Dressed and matched—boards which have been machined in such a manner so that the tongue of one plank will fit into the groove of the other.

Drip cap—a metal cap placed over a door or window to drain the moisture off the door frame.

Dry wall construction—a type of interior wall construction which uses gypsum wall board.

Ducts—round or rectangular pipes used for distributing warm or cooled air.

Dutchman—a piece of roofing fitted over poorly made corner or cut.

Eaves—the portion of the roof extending over the exterior walls.

End-matched—a manner of cutting strip flooring so that the ends meet and match; e.g., tongue and grooved.

Expansion joint—a deliberate break filled with bituminous fiber or plastic material between blocks or sections of masonry work used to prevent cracking due to expansion and contraction.

Exposure—the portions of the exterior construction materials which are left unprotected.

Face—the open side or portion of construction that is exposed.

Face nail—a nail driven perpendicular to the surface of the material nailed.

Fascia—a board used in the construction of a cornice — usually nailed to the lookouts.

Felt—building paper used for weather-proofing under roofing and siding.

Fiberboard—an artificial board of pressed fiber or other material.

Finish hardware—all hardware (hinges, pulls, etc.) which are exposed.

Finishing nail—a wire nail specifically designed for finish work.

Firestop—a block of wood placed between studs or joists to obstruct the spread of fire inside a wall.

Fire wall—walls used to subdivide a building to prevent the spread of fire.

Fish mouth—a ripple, seam or bulging opening on a roof surface.

Flashing—material used to waterproof roof joints, edges and around items that protrude through a roof.

Flash point—the temperature at which the vapors from a given substance will burn if ignited.

Floating partition—a partition which rests on a floor between joists and parallel to them.

Flu—a space or passage through which smoke or hot gasses pass.

Flush—two adjacent structural pieces that are even and on the same plane.

Flush door—a door which has an absolutely flat surface.

Footing—the wider area at the base of a foundation, wall or column made of formed, poured-in-place concrete.

Foundation—the supporting section of a structure.

Framing—the timber structure of a building or component which gives it strength and shape.

Framing anchors—fabricated metal devices used to facilitate installation and add strength to rafters, headers, joists, etc.

French doors—doors which are made up of a series of glass panes.

Frieze—a board forming a band directly under the cornice.

Furring—a method of applying wooden strips to a wall, floor or ceiling on which the finish material is applied.

Gable—the vertical, triangular end section of a building.

Gable roof—a double-sloping, ridged roof.

Gambrel roof—similar to a gable roof but with a change of slope on each side.

Girder—a large, principal beam used to support major loads.

Glazing—the placing of glass in the frames of windows or doors.

Gutter—a trough used to carry water off of the roof.

Hardwood—the wood of a select group of trees known for hardness—oak, maple, hickory, etc.

Header—a horizontal, structural member which supports the load over an opening (usually a window or door).

Hearth—the fireproof part around the front of a fireplace.

Heel—the end of a rafter supported by the wall plate.

Hexagonal shingle—a composition shingle with six sides.

Hip—the external angle formed by the meeting of two adjacent sloping roofs.

Hip rafter—the corner rafter of a hip roof.

Hip roof—a roof which slopes to all sides of the roof line.

Holiday—a mistake usually made by missing or skipping a portion of the normal construction process.

Hotstuff—asphalt or coal tar heated to a molten state.

Insulating board sheathing—sheathing which has a standard thickness of 25/32", is water proofed with asphalt, and is used behind rock or brick veneer.

Insulation—any material which, when placed in walls, ceilings, floors, etc., retards the passage of heat or sound.

Jack rafter—a shorter rafter, such as that used from a valley to a ridge or from a wall plate to a hip.

Joasam drain—a patented outlet or drain used on flat roof decks.

Joist—a horizontal framing member used to support floors and ceilings.

Joist hangers—(stirrups) a specifically formed metal strap used to secure a joist to a girder.

Junction box—any electrical box where wiring is connected, switched, etc.

Kerfing—shallow saw grooves cut in the backside of materials, usually to facilitate bending.

Kiln dried—a method of curing and drying lumber by means of applying heat and controlling humidity.

Knockdown—any article which has all mill work completed and is ready to be assembled.

Lag screw—a square or hex-headed, bolt-like fastener with tapered, auger type threads.

Lally column—cylindrically shaped, steel columns sometimes filled with concrete and used to support short beams or girders.

Laminated—the bonding together of several pieces to form one piece.

Laminated beam—a beam composed of several boards held together by glue, nails or other fasteners.

Leader—a down spout which carries water from the roof to the ground.

Lintel—a horizontal member used above windows and doors to help support the wall above the opening.

Lock set—a lock with all trim, striken plate, screws, etc.

Lookouts—the projecting ends of framing members to which finishing boards are nailed.

Louver—openings which are slotted and screened or otherwise constructed to permit ventilation, but keep out rain and sunlight.

Mantel—the shelf or top section of a fireplace.

Mastic—an adhesive used to secure flooring, wall panels and other materials.

Matched lumber—lumber that is edge dressed to match, such as tongue and grooved.

Mission tile—a curved, tapering tile unit.

Miter—the joining of two members, each cut at complementary angles, in order to form a corner.

Miter box—a jig or box which guides a saw for cutting material at 45 and 90 degree angles.

Moisture barrier—a method of treating or sealing moisture out of a structure, wall, slab, etc.

Mop yarn—a material, usually of cotton or fiber glass, used to make roofing mops.

Ogee or O.G.—a molding having a section shaped like the letter "S".

On center—a method of measuring the spacing for joists, studs, rafters, etc.

Overhang—the portion of the roof extending past the wall.

Panel door—a door made up of styles, rails and insert panels.

Parquet flooring—usually blocks of flooring made of quarter-sawed hardwood or any wood floor in which the pattern resembles an assembly of squares.

Penny—a term used to designate the size of nails—eight penny, sixteen penny, etc. Usually written as "d".

Picture molding—a molding set horizontally around the walls near the ceiling from which pictures can be hung.

Pier—a horizontal, rectangular, masonry column used to support other structural members.

Pilaster—a supporting section of a wall that extends not more than half its own width beyond the wall in which it stands.

Pitch—the degree of incline of a slope (usually referring to a roof).

Plain sawed—a method of cutting wood that exposes the face of the grain.

Plate—horizontal members secured to the ends of studs.

Plumb—exactly vertical; perpendicular to the surface of a floor.

Ply—a term to denote a thickness or layer, as in plywood, roofing felt, etc.

Pre-cutting—the practice of cutting material to a specified shape and size before hauling it to the construction site.

Prefabricating—units or sections assembled at a factory or on site so as to minimize construction time.

Quarter sawed—a method of cutting wood that exposes the edge grain.

Rabbet—a type of wood joint; a groove cut parallel and adjacent to the end of a board.

Rafter—a member commonly running from ridge to wall in a series with others.

Rake—the sloping edge of a gable roof.

Ramp—an inclined plane connecting two or more surfaces on different levels.

Retaining wall—any wall built with the specific purpose of retaining a particular material.

Reversed door—a door which opens in any way which is not considered regular.

Ridge—the highest horizontal line where two roof slopes meet.

Ridge board—(ridge pole) a member running the length of the ridge to which the upper ends of the rafters are attached.

Ridge roll—a metal cap used to cover and finish the ridge.

Ridge shingles—overlapping shingles which cover the ridge.

Rise—the increase of actual height per foot of run on a rafter.

Roof sheathing—boards or plywood secured to the rafters.

Roughing-in—the building of structural members which are not visible in the completed structure.

Rung—a cross strip or "step" of a ladder.

Saddle—a water diverter between the chimney and the high side of the roof, sometimes called a "cricket".

Scaffold—temporary structure or platform used to support workmen and materials during the construction operations.

Scarfing—the joining of two pieces of material together with a slanting lap joint so that it appears as one.

Screed—(sleeper or nailer) members attached to concrete slabs on which flooring may be nailed.

Selvage edge—a type of roll roofing which is overlapped and secured with mastic.

Shake—a roughly shaped wooden shingle, usually hand split.

Sheathing—a structural covering, usually consisting of panels, boards or prefabricated panels.

Shim—(1) a wedge-shaped piece of material used for leveling.
(2) to block up — usually with thin strips of level or raise.

Shiplap—lumber with edges rabbeted to form a lap joint along the edge of adjacent pieces.

Shoe mold—quarter round or other decorative molding used to cover the joint of the baseboard and flooring usually made of hardwood.

Shoring—lumber and timbers used to prevent the movement of earth, plastic concrete or other matter.

Siding—the finished covering of an outside wall of a frame building.

Sill—the lowest horizontal member of a building foundation.

Skein—a fixed quantity of yarn used in making roofing mops.

Skylight—a window facing the sky; usually located on a roof.

Slate—a fine-grained rock used for roofing shingles.

Sleeper—see screed.

Slip sheet—(dry sheet) a first coat of paper used to prevent roofing material from adhering to the sheathings.

Soffit—a board (or other material, such as aluminum) used on the bottom side of a cornice.

Softwood—wood from a coniferous tree.

Span—the distance between structural supports on any particular member.

Specifications—a written document specifying the type, quality and quantity of materials and the installation process.

Spreader—in concrete forming, pieces of wood, metal or other material designed to keep the wall of the form separated the proper distances.

Spreading note—the quantity of asphalt bitumen or other roofing material that may be spread over a roof deck in a certain time.

Square—a given measure of roofing material able to cover 100 square feet.

Square-edge flooring—strip flooring that is not tongue and grooved or otherwise jointed.

Stile—the outside, vertical members of a window or door.

Strike—(striking plate, striker, keeper) a metal plate attached to a jamb to which a door may be latched, bolted or shut.

Strip flooring—flooring that is installed in courses or strips.

Stud—one in a series of vertical wood or metal members in a wall or partition.

Sub-floor—wooden flooring laid on the floor joists.

Threshold—a piece of metal or wood set beneath an outside door but above the finished floor.

Ties—may be of wire or metal and are used to keep the walls of a form from separating when concrete is poured.

Tile—a baked ceramic product in a variety of shapes and sizes.

Toeboard—a board secured to a sloping roof to give workers secure footing.

Transom—a small window directly above a door or window.

Truss—a group of members joined and designed so as to mutually support itself and the weight of the roof.

Valley—the inverse angle formed by the meeting of two roof slopes.

Veneer—thin sheets of wood less than 1/4 inch thick.

Wainscot—any material applied to the lower section of an interior wall so that it contacts the upper section.

Wallboard—may be of gypsum, pulp or other materials, usually made in 4′ x 8′ sheets.

Weeper—a small opening at the base of a skylight to allow the drainage of any moisture collected.

Weephole—a small hole at the base of a masonry wall made so that moisture will drain from behind the wall.

Whaler (*waler*)— a horizontal member used in the construction of concrete forms.

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101 Constitution Avenue, N.W.
Washington, D.C. 20001
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1619 Massachusetts Avenue, N.W.
Washington, D.C. 20036

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ROOFING

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Asphalt Roofing Manufacture Association
757 Third Avenue
New York, New York 10017

Gypsum Roof Deck Foundation
1201 Waukegan Road
Glenview, Illinois 60025

National Roofing Contractors Association
1515 N. Harlem Avenue
Oak Park, Illinois 60302

Publication: (1) *The Roofing Spec*, (2) *Action Information Bulletin*, and (3) *NRCA Roofing Manual*.

Roof Drainage Manufacturers Institute
221 North LaSalle Street
Chicago, Illinois 60601

United Slate, Tile, and Composition Roofers Damp and Waterproof Workers Association
1125 17th Street, N.W.
Washington, D.C. 20036

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Fine Hardwoods-American Walnut Association
666 Lake Shore Drive
Chicago, Illinois 60611

Floor Covering Distributors Council
c/o General Floor Products
Route 22
Springfield, New Jersey 07081

Maple Flooring Manufacturers Association
424 Washington Avenue
Oshkosh, Wisconsin 54901

Publishes pamphlets on installation and finishing of hardwood flooring.

National Association Floor Covering Installers
4301 Connecticut Avenue, N.W., Suite 436
Washington, D.C. 20008

Publication *NAFCI*

National Oak Flooring Manufacturing Association
814 Sterick Building
Memphis, Tennessee 38103

Publications: (1) *Architect's Specification Manual,* (2) *Hardwood Flooring Handbook,* and (3) *Homeowner's Guide.*

Wood and Synthetic Flooring Institute
R.G. Bredon & Associates, Inc.
1201 Waukegan Road
Glenview, Illinois 60025

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ADDITIONAL SOURCES OF INFORMATION ON TRIM

Architectural Aluminum Manfacturers' Association
410 N. Michigan Avenue, 9th. Floor
Chicago, Illinois 60611

Federation of Societies for Paint Technology
121 South Broad Street
Philadelphia, Pennsylvania 19107

National Home Improvement Council
11 E. 44th Street
New York, New York 10017

Painting and Decorating Contractors of America
2625 West Peterson Avenue
Chicago, Illinois 60659
(Apprentice Training)

National Decorating Products Association
2101 S. Brentwood
St. Louis, Missouri 63144

United Brotherhood of Carpenters and Joiners of America
101 Constitution Avenue, N.W.
Washington, D.C. 20001

Monthly Publication: *The Carpenter*

Western Wood Moulding and Millwork Producers
P.O. Box 25278
Portland, Oregon 97225

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ABSTRACT: THE PURPOSE OF THIS INSTRUCTOR'S GUIDE IS TO OUTLINE A SERIES OF TRAINING EXPERIENCES RELATED TO OCCUPATIONS IN FINISHING THAT CAN LEAD A STUDENT TO AT LEAST ENTRY-LEVEL JOB PROFICIENCY. THE GUIDE IS DIVIDED INTO SEVERAL TEACHING UNITS, EACH WITH AN OVERALL OBJECTIVE. THERE ARE FURTHER DIVISIONS LISTING SUBOBJECTIVES WHICH, WHEN SUCCESSFULLY COMPLETED BY THE STUDENT, WILL SATISFY THE OVERALL OBJECTIVE FOR A SPECIFIC UNIT. SUGGESTED ACTIVITIES ARE LISTED UNDER THE SUBOBJECTIVES AND ARE SUPPORTED BY A NUMBER OF TEXTS. SOURCES OF INFORMATION AND AN OUTLINE OF "ACADEMIC RELATED THEORY AND INFORMATION" ARE ALSO INCLUDED IN EACH UNIT. UNIT TITLES FOR THIS GUIDE ARE: INSULATING, DRYWALL, PAINTING AND WALLCOVERING, GLASS AND GLAZING, FLOOR COVERING, AND LANDSCAPING. APPENDED IS A SAMPLE LESSON PLAN. THIS DOCUMENT SHOULD BE USED IN CONJUNCTION WITH THE STUDENT MANUAL FOR FINISHING (VT 102 410 IN THIS ISSUE). (AUTHOR/LJ)

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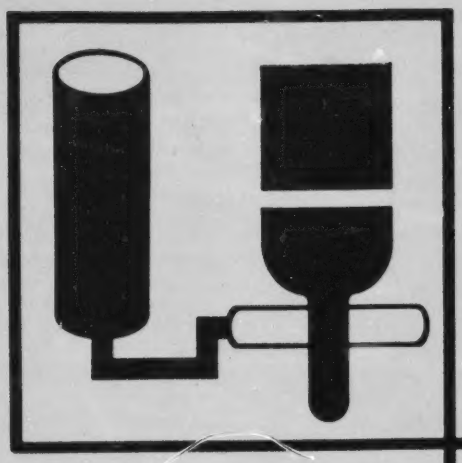

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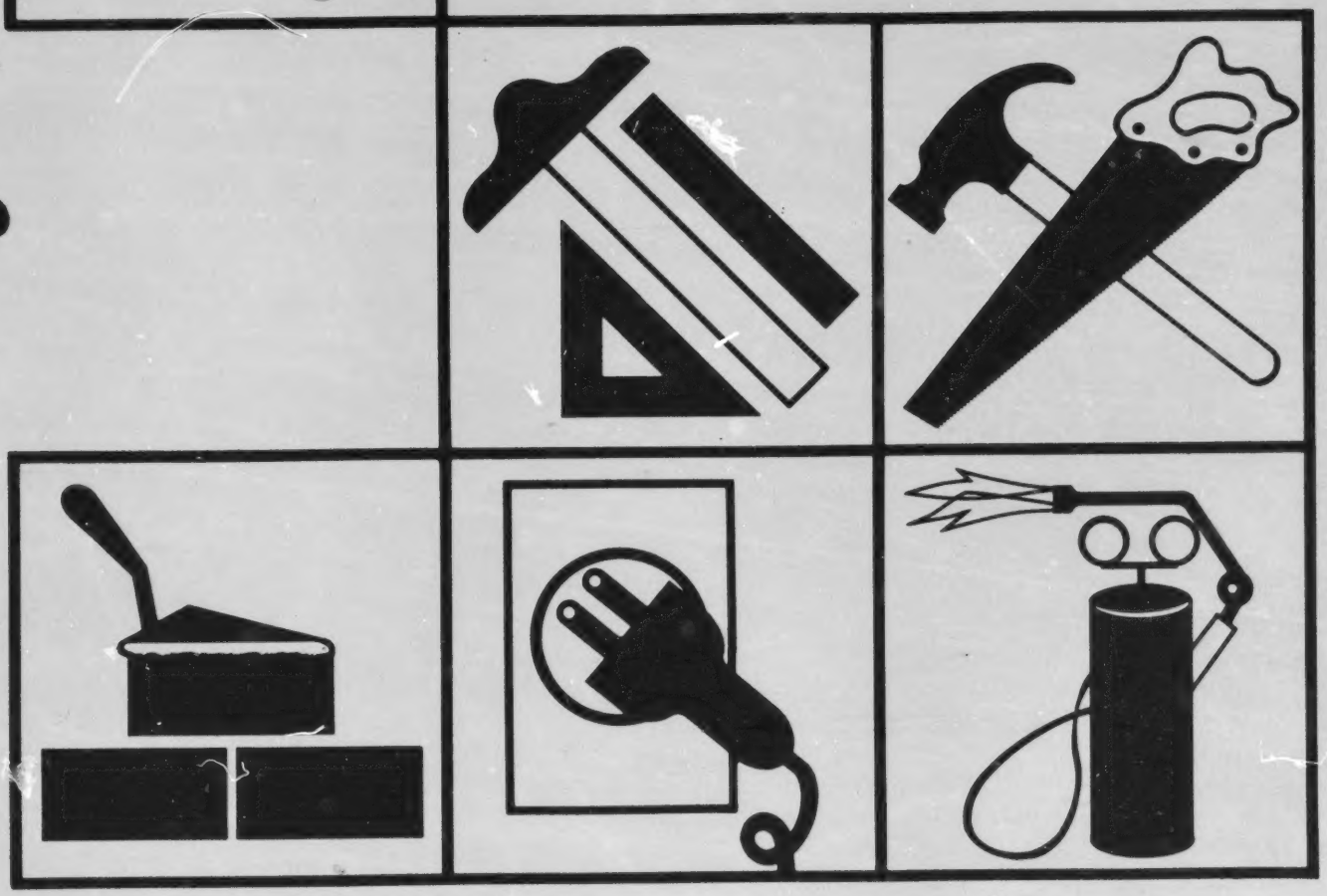

construction industry series
instructor's guide
preparation level

VT 102 409

2

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This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

EXPLORATION LEVEL:

Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

OCCUPATIONAL PREPARATION LEVEL:

Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
Metal - Student Manual
Metal - Instructor's Guide
Electricity - Student Manual
Electricity - Instructor's Guide
Masonry - Student Manual
Masonry - Instructor's Guide

In addition, there is an Articulation Guide designed for these instructional materials in construction.

Articulation Guide - Construction Industry Series

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INTRODUCTION TO FINISHING
OCCUPATIONAL PREPARATION

PURPO

The purpose of this guide is to outline a series of training experiences that can lead a student to at least entry-level job proficiency. The instructor guide is divided into several teaching units, each with an overall objective. There are further subdivisions listed as sub objectives which will satisfy the overall objective for a specific unit when successfully completed by the student. Suggested activities are listed under the sub objective and are supported by a number of texts.

Use of behavioral objective format may or may not be new to you. There are a few basic components which acceptable behavioral objectives must include. First, all behavioral objectives must be directed toward student performance. Second, they must clearly state action or behavior which a student must perform. Third, there must be some criteria by which you can measure the success or failure of that action or behavior.

The establishment of a series of measurable goals for each student can individualize the education and training process. If a student can demonstrate skill in certain basic tasks to the satisfaction of the instructor, the student can move on to tasks which are more challenging. Instructing all of your students in the performance of a task, in which many of them are already proficient, can severely affect enthusiasm and motivation. This problem can, in large part, be overcome by the use of a pretest designed to provide a beginning point from which the student can start his or her training. The systematic use of planned instructional outcomes (behavioral objectives) can serve to more effectively motivate students.

The instructor's guide makes no attempt to set down absolute standards defining successful student performance. It will be your responsibility to establish these performance levels for your students. Some performance standards, such as working safety, should probably be set at the 100 percent level. Your professional judgment, and the abilities of your individual students, provide the basis for determining the standard which students must meet before proceeding to another task objective.

PROGRAM APPROACH AND TECHNIQUE

During the exploratory phase of the Construction Program, students are encouraged to explore several job families in construction. As they enter your class, they have made a more refined choice and should now be prepared to develop a number of specific skills.

To accomplish the purpose of this program, a two-fold approach has been taken. The material has been organized into two distinct components -- Instructor's Guide and Student Resource Manuals.

The Instructor's Guide is organized into a task-by-task outlining of suggested activities structured around behavorial objectives.

LESSON PLANNING

Organization and planning are essential to the success of any program. The four-step lesson plan recommended procedure is:

Step 1 Preparation of the Lesson. Applying the principle of Readiness, the instructor should prepare students for the lesson. Information sheets, reading assignments in the text and Student Resource Manual and other introductory techniques can help to prepare the student.

Step 2 Presentation. Applying the principle of Effect, the instructor should present and demonstrate a given process or activity supported by media and selected student involvement. Tell and show how to do the task step-by-step, citing critical check points and special safety requirements.

Step 3 Application of student performance. Applying the principle of Practice, the instructor should permit the students to do the assigned task. Special work sheets, drawings and instructions should be provided the student when necessary.

Step 4 Performance test. Applying the principle of Criteria, referenced testing is used to determine student performance at acceptable levels. Those students who do not meet acceptable performance standards are cycled through Steps 2, 3 and 4 again.

(See Appendix, Sample Lesson Plan)

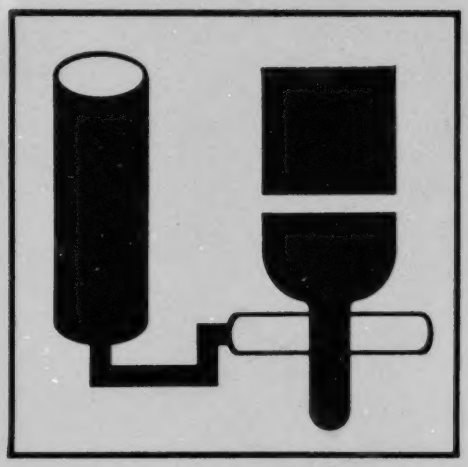
STUDENT RESOURCE MANUAL

The Student Resource Manual is intended to serve as a supplemental text and information manual. It is designed and written for student use and it is structured to compliment the Instructor's Guide. Subjects such as tools and equipment, materials, processes and safety are discussed. A glossary of terms is included in each student manual.

The success or failure of a preparation program can depend on many things. It is hoped that you will encourage student participation in youth organizations which promote scholarship and craftsmanship. VICA organizations have been very successful in motivating and recognizing student accomplishments. If your school does not have a VICA chapter, you can be instrumental in starting one. The rewards to the community, school, and especially the student, can be readily apparent. Other student organizations, such as DECA, may be of interest to students aiming for careers in the wholesaling and retailing of construction products.

Of further value to your program would be the establishment and maintenance of a strong advisory committee. The involvement of members of the community can help to promote your program. A committee of this kind can form a solid bridge between school and community. If your school does not have a construction advisory committee, it is time to start one. The exchange of ideas can benefit both the school and community.

INSULATING



FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to install batts and blankets.

SOURCES OF INFORMATION

Wagner, Willis, H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material sizing
- Tool and equipment sizing

Science

- insulation
  - Theory
  - Materials
  - Properties
  - "U" factors
  - Vapor barriers

Communication Skills

- Related safety
  - Protective clothing
  - Cutting devices
- Manufacturer's literature
- Student Resource Manual
- Vocabulary development

FINISHING

CONTENT TITLE: Batts and Blankets

SUB OBJECTIVE 1: The student will demonstrate ability to measure and cut blankets to the required size.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates measuring and cutting blankets to the required size (s).

   A. Measure required length and mark length on floor.
   B. Unroll blanket and align with marks on floor.
   C. Allow an extra 2 or 3" and cut insulation with a fine-toothed cross-cut hand saw, shears or large knife.
   D. Remove strip of insulation from each end to provide space for stapling at top and bottom.
   E. Emphasize that appropriate protective clothing should be worn at all times, regardless of ambient temperature. Fibres are quite irritating to the skin.

II. Students measure and cut blankets to required size.

FINISHING

CONTENT TITLE: Stapling

SUB OBJECTIVE 2: The student will demonstrate ability to staple blankets to studs in walls and ceilings.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates stapling blankets to studs.

A. Begin at ceiling and staple top end to plate.
B. Place remaining portion of batt securely in place and staple flanges to studs on each side.
C. Staple flanges to studs 12" o.c., maximum.
D. Butt second batt securely against first and staple along flanges with a staple gun.
E. Continue process until reaching bottom. At bottom, staple last batt securely against adjoining batt and along flanges and against sole plate.
F. Thread insulation around drain pipes.
G. Do not cover electrical boxes. Push as much insulation as possible around and behind them.

II. Students staple blankets to studs in walls, ceilings and floors.

FINISHING

CONTENT TITLE: Stapling

SUB OBJECTIVE 3: The student will demonstrate ability to install batts and blankets on drywalls and in odd spaces.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing batts and blankets on drywall and in odd spaces.

   A. If framing faces are uncovered, and there are no studs to serve as base for attaching insulation, staple batt flanges together as in ordinary framing.
   B. After main areas of ceilings and walls are covered, spaces above and below windows and doors are covered.
   C. Use small remnants for covering small spaces, overlapping flanges as before.

II. Students install batts and blankets on drywall and in odd spaces.

FINISHING

CONTENT TITLE: Vapor Barriers

SUB OBJECTIVE 4: The student will demonstrate ability to install a vapor barrier over an insulated wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing vapor barrier material.

A. Complete installation of batts or blankets. Ensure that material fits closely around plumbing, electrical and heating fixtures.

B. Lay sheets of polyethylene film or aluminum foil over surface of batts.

C. Overlap sheets at edges by at least 3" and staple joints with a staple gun, 6" o.c., maximum.

D. Cút and fit around obstructions such as electrical outlet boxes, etc., carefully. If specified, caulk around such openings to ensure an airtight and watertight fit.

II. Students install vapor barrier material.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to install fill-type insulation in ceilings, walls and partitions.

SOURCES OF INFORMATION

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Square feet and cubic feet computations

Science

- Properties of vermiculite, mineral wool, perlite

Communication Skills

- Related safety
  - Working "over ceilings"
  - Using ladders
  - Using power equipment
- Manufacturer's literature
- Student Resource Manual

FINISHING

CONTENT TITLE: Fill Insulation

SUB OBJECTIVE 5: The student will demonstrate ability to install fill-type insulation in ceilings.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing fill-type insulation in ceilings.

A. Install vapor barrier on underside of joists prior to application of ceiling finish materials if possible. If not, drape polyethylene films from joist to joist, loosely enough to allow material to "hug" joists when fill is applied.

B. Emphasize safety precautions to be observed when blowing or pouring fill-type instulation; i.e., use of protective eye and breathing apparatus, gloves, etc.

C. Pour or blow material into spaces between joists. Do not compress or vibrate to settle.

D. Screed material with a long straightedge, bringing to level of top of joists. If an excess has been applied, it is better to push excess into corners and along perimeter of outside walls.

II. Students install fill-type insulation in ceilings.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to install polystyrene or urethane foam insulation blocks in masonry wall cavities and to plaster-base walls.

SOURCES OF INFORMATION

Lin-Foam Construction Specifications, (Lin Construction Co.: P. O. Box 247, Clinton, Oklahoma).

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Properties of expanded styrene and urethane
- Other uses of urethane insulation

Communication Skills

- Manufacturer's literature
- Student Resource Manual

FINISHING

CONTENT TITLE: Fill Insulation

SUB OBJECTIVE 6: The student will demonstrate ability to install fill-type insulation in already closed walls and partitions.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing fill-type insulation in walls and partitions.

   A. Discuss difficulties involved in installing this material in walls; i.e., it is difficult to determine if insulation is filling wall completely. Large air-pockets are caused by almost any obstacle in the wall. Moreover, fire stops are located at irregular elevations, and prevent filling wall below mid-point without plugging wall between each stud.
   B. Demonstrate locating fire stops.
   C. Demonstrate plugging walls to allow insertion of blow pipes.
   D. Blow insulation into lower portions of walls first. Wall finishing people will have to repair holes.
   E. Blow or pour insulation into upper portion of wall and level with ceiling fill.
   F. Tap or vibrate wall to allow pockets an opportunity to fill.

II. Students fill walls and partitions with loose insulation.

FINISHING

CONTENT TITLE: Cavity Walls

SUB OBJECTIVE 7: The student will demonstrate ability to install polystyrene or urethane slabs to masonry cavity walls.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing polystyrene or urethane slabs to masonry cavity walls.

   A. Determine that walls are plumb and true to dimensions.
   B. Ensure that all mortar joints are full. If not, caulk or patch cracks and crevices.
   C. Ensure that interior and exterior walls are tied together with non-corroding metal ties embedded in mortar, preferable at every 8th course.
   D. Position 16" from boards in wall, butting firmly against metal ties and against each other.
   E. Attach board to interior walls by applying adhesives supplied by manufacturer in spots as specified. Follow manufacturer's recommendations in all adhesive applications.
   F. If cutting is required, note that polystyrene may be cut to any desired shape with a large knife or fine-toothed saw. If hot-wire cutting tools are available, instructor should demonstrate their use and discuss the safety precautions which should be observed.
   G. Do not use petroleum-based adhesives with polystyrene slabs, as the plastic tends to melt when placed in contact with these materials.

II. Students install polystyrene or urethane slabs to masonry cavity walls.

FINISHING

CONTENT TITLE: Plaster-base walls

SUB OBJECTIVE 8: The student will demonstrate ability to install polystyrene or urethane foam insulation to plaster-base walls.

SUGGESTED ACTIVITIES. (Students and Teachers)

I. Instructor demonstrates applying polystyrene or urethane foam insulation to plaster-base walls.

   A. Apply cement to outer 2" of perimeter of each block and to exposed edges of adjacent blocks.
   B. Butt blocks firmly into position.
   C. Cover major surfaces of walls and ceilings in this manner.
   D. Cover odd spaces above and below doors and windows with pieces cut to fit area. Apply adhesive as for large blocks. In very small areas, adhesive may also be applied to edges of blocks to join small blocks to adjoining large ones.

II. Students apply polystyrene or urethane foam insulation to plaster-base walls.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to measure, cut and variously install blocks of polystyrene foam insulation.

SOURCES OF INFORMATION

Lin-Foam Construction Specifications, (Lin Construction Co.: P. O. Box 247, Clinton, Oklahoma).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review math requirements for job entry or higher education

Science

- Review science requirements for job entry or higher education

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Review communication skills required for job entry or higher education
- Review job and career opportunities
  - Apprenticeship
  - Job
  - Higher education and training

FINISHING

CONTENT TITLE: Polystyrene or Urethane Blocks

SUB OBJECTIVE 9: The student will demonstrate ability to measure and cut blocks of polystyrene or urethane foam insulation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates measuring and cutting polystyrene or urethane boards.

   A. Measure space to be fitted with a tape measure.
   B. Lay out dimensions of space with a tape measure and snap chalk lines.
   C. Cut along chalk lines with a sharp knife.
   D. Trim away any remaining rough edges with the knife.

II. Students measure and cut polystyrene or urethane boards.

FINISHING

CONTENT TITLE: Polystyrene or Urethane Blocks

SUB OBJECTIVE 10: The student will demonstrate ability to install polystyrene block on the wooden walls of a cooler.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installing polystyrene blocks as cooler insulation.

II. Instructor demonstrates polystyrene block installation.

A. Remove loose paint from walls.
B. Nail down or replace loose or defective boards.
C. Cover boards with insulating paper; overlap paper by 2".
D. Tack insulating paper down.
E. Apply 140°-180° melt asphalt at 200° to the back of polystyrene insulating board with a trowel.
F. Apply polystyrene blocks to insulating paper and butt together.
G. Fasten blocks to wall with galvanized nails.
H. Apply a second layer of blocks in same way as first.

III. Students install polystyrene or urethane blocks to the wooden walls of a cooler.

FINISHING

CONTENT TITLE: Polystyrene or Urethane Blocks

SUB OBJECTIVE II: The student will demonstrate ability to install polystyrene or urethane blocks to the masonry walls of a cooler.

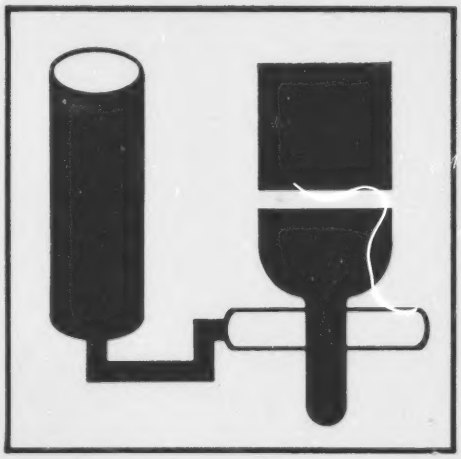
SUGGESTED ACTIVITIES: (Students and Teachers)

I. The instructor will demonstrate installing polystyrene or urethane blocks on the masonry walls of a cooler.

   A. Remove all loose mortar from walls.
   B. Apply 140°-180° melt asphalt at 200° to walls of a cooler with a trowel.
   C. Apply polystyrene blocks to wall surface and butt together.
   D. Apply a second layer in the same fashion as the first.
   E. Fasten second layer to the first with wooden skewers.

II. Student install polystyrene or urethane blocks on the masonry walls of a cooler.

DRYWALL



FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to apply wallboard to standard construction ceilings and walls.

SOURCES OF INFORMATION

Drywall Construction Workbook, Part 1, (California State Department of Education: 721 Capitol Mall, Sacramento, California 95814), 1969.

Gypsum Drywall Construction Handbook, (United States Gypsum Co.: Department 122, 101 South Wacker Drive, Chicago, Illinois 60606), 1971.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Level, plumb and square
- Material and tool sizing

Science

- Composition and advantages of gypsum wallboard

Communication Skills

- Related safety
  - Handling drywall sheets
  - Fall hazards
  - Power equipment usage
- Blueprint reading and symbols
- Student Resource Manual
- Manufacturer's literature

FINISHING

CONTENT TITLE: Cutting

SUB OBJECTIVE 1: The student will demonstrate ability to cut wallboard to a variety of configurations using scoring and snapping as well as hand and electric cutting techniques.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates scoring and snapping wallboard.

A. Discuss safety.
B. Measure for cut and mark, demonstrating use of straightedges.
C. Demonstrate scoring into core, snapping and cutting back paper.
D. Trim edges and smooth down using special tools or wire lathe tacked to wood blocks.
E. Measure fixtures and openings for cutouts and mark wallboard for cutting.
F. Cut openings for fixtures using hand and electric tools.

II. Students score, snap and cut wallboard.

FINISHING

CONTENT TITLE: Inspection

SUB OBJECTIVE 2: The student will demonstrate ability to inspect walls and ceilings to determine their acceptability as a mounting surface and to correct defects prior to the application of wallboard.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor outlines and demonstrates the correction of framing defects.

A. Discuss the difficulties likely to occur when framing members, ceiling or floor joists are out of alignment. (Nail heads will puncture paper; nails will later pop.)

B. Demonstrate correcting for framing members out of alignment.
1. Shim out recessed members flush with adjoining surfaces.
2. Alternately, plane down protruding surface or reinstall component.
3. Use adhesive-nail method of installation for wallboard or use wallboard with rounded edges to allow smoother bedding and floating of joint.
4. Add carefully cut braces and toe-nail members to braces to pull into alignment.

C. Discuss the difficulties likely to occur when framing members are twisted (nail heads will puncture paper; reverse twisting of members is likely to occur with concurrent loosening of wallboard).

D. Demonstrate correcting twist in framing members.
1. Correct twist by reinstalling.
2. Add carefully cut braces and toe-nail members to braces to pull into alignment.
3. Plane high areas to level and shim lower portions.
4. Use wallboard material with rounded edges to allow smoother bedding and floating of joint.

E. Discuss the difficulties likely to occur when framing members are bowed (bowed members are rarely stable; loosening of wallboard as members continue to buckle).

Continued.

FINISHING

CONTENT TITLE: Inspection (Continued)

SUB OBJECTIVE 2: The student will demonstrate ability to inspect walls and ceilings to determine their acceptability as a mounting surface and to correct defects prior to the application of wallboard.

SUGGESTED ACTIVITIES: (Students and Teachers)

F. Demonstrate correcting bow in framing members.
   1. Saw a notch in the hollow side of the bow. Drive a wedge into the kerf to draw stud straight. Reinforce member with scabs (1 x 4's nailed to the sides).
   2. If only one member is bowed, it may be braced to adjoining members.

G. Discuss the difficulties likely to occur when there are protrusions in the framing system (wallboard floats and protrusions puncture paper; boards become loosened, etc.)

H. Demonstrate correcting protrusions in the framing system.
   1. Incorrectly installed headers, bridging, etc. may be reinstalled.
   2. Alternately, plane down protrusions; do not shim up.
   3. Cut notches and relocate wiring and other protruding objects.

II. Students correct framing defects prior to installation of wallboard.

FINISHING

CONTENT TITLE: Nailing and Screwing

SUB OBJECTIVE 3: The student will demonstrate ability to attach wallboard to existing wood and metal studs using the standard hammers and nailing techniques illustrated.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates nail and screw application with manual and electric tools.

   A. Introduce hammer sizes and correct usage.
   B. Introduce types and sizes of nails and screws.
   C. Demonstrate flush and countersink nailing.
   D. Demonstrate single and double nailing spacing.
   E. Demonstrate use of expansion bolts.
   F. Demonstrate use of electric and Yankee screwdrivers.
   G. Stress safety throughout demonstrations.

II. Students attach wallboard using nails, screws and expansion bolts.

FINISHING

CONTENT TITLE: Vertical and Horizontal Application

SUB OBJECTIVE 4: The student will demonstrate ability to apply wallboard using horizontal and vertical methods.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates horizontal methods of drywall application.

   A. Define horizontal and vertical methods.
   B. Outline advantages and disadvantages of each.
   C. Lay out room for horizontal application. Lay out work so that longest pieces go first, and so that no joints fall immediately above edges of windows, doors, etc. Lay out work to start at ceiling and finish with walls.
   D. Demonstrate various methods of working around openings; including horning, picture-cut, over-and-under and picture frame methods. Remind students that some of these methods require much practice.
   E. Demonstrate layout for vertical method. Emphasize disadvantages but outline typical areas of application.

II. Students apply wallboard by the vertical and horizontal methods.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to apply wallboard using the single and double layer methods, horizontal and vertical applications, single and double layer and to apply appropriate joint treatment to installed drywall systems.

SOURCES OF INFORMATION

Drywall Construction Workbook, Part 1, (California State Department of Education: 721 Capitol Mall, Sacramento, California 95814), 1969.

Federal Housing Administration, Department of Housing and Urban Development, Minimum Property Standards for One and Two Living Units, (Order from GPO, Document No. HH2.17/4:965).

Gypsum Drywall Construction Handbook, (United States Gypsum Co.: Department 122, 101 South Wacker Drive, Chicago, Illinois 60606), 1971.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Estimating

Science

- Adhesives and joint compounds

Communication Skills

- Manufacturer's and technical literature
- Vocabulary development
- Student Resource Manual

FINISHING

CONTENT TITLE: Single and Double Layer Applications

SUB OBJECTIVE 5: The student will demonstrate ability to install wallboard and soundboard, single and double layer method, attaching to standard studding and to furring.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates horizontal, vertical and double layer methods of installing wallboard.

   A. Measure, mark and cut wallboard to fit.
   B. Apply furring strips on old wall surfaces.
   C. Using jack, attach vertical pieces; start at top and work down. Use wedges for supporting lower pieces.
   D. Pre-bow pieces of wallboard by storing overnight, leaning diagonally against a wall.
   E. Start second layer, horizontal application, working from top down. Hold or tack in place while adhesive sets.

II. Students install double layer wallboard using vertical and horizontal placement.

FINISHING

CONTENT TITLE: Adhesives and Double Layer Method

SUB OBJECTIVE 6: The student will demonstrate ability to apply wallboard using adhesives and the double layer method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying wallboard using adhesives and the double layer method.

   A. Apply base layer to ceiling using horizontal method. End joints may float or fall on joists.
   B. Apply base layer to walls vertically except where predecorated panels are to be used to finish installation; in this case, use horizontal method for base layer.
   C. Spread adhesive uniformly over entire back surface of face layer board using a laminating spreader or metal spreader blade.
   D. Laminate face layer to mounting surface using temporary nailing, supports or screws.
   E. Strike sheets with palm of hand, or press firmly to base layer to ensure good cement spread and adhesion. Wipe off any excess cement which may be forced out between joists.
   F. After cement has been allowed to set (usually two full days), remove temporary nailing or shoring. Screws may be left in place for later treatment.

II. Students apply wallboard using adhesives and the double layer method.

FINISHING

CONTENT TITLE: Finishing Joints

SUB OBJECTIVE 7: The student will demonstrate ability to neatly bed, tape and feather edges of wallboard joints.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the mixing of compounds, bedding of joints and application of tape.

   A. Discuss types and uses of compounds.
   B. Demonstrate mixing compounds for right consistency.
   C. Demonstrate bedding joints using concave trowel.
   D. Demonstrate applying tape with trowel and wide putty knife.
   E. Demonstrate use of tape box.
   F. Demonstrate finishing rough edges.

II. Students mix compounds, bed joints and apply tape.

FINISHING

CONTENT TITLE: Furring Strips

SUB OBJECTIVE 8: The student will demonstrate ability to determine the desirability of applying wood or metal furring and will apply both wood and metal furring to wood and masonry surfaces.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses applications of furring and criteria for selection.

A. Discuss use of wood furring in residential applications where it is desired to cover an existing surface or where it is necessary to apply wallboard to framing so rough that correcting all difficulties would be prohibitively expensive.

B. Discuss insulation (both sound and thermal) advantages which accrue from the use of furring.

C. Discuss applications of metal and resilient metal furring (mention suspended ceilings, metal, non-structural wall applications, quiet-zone walls, walls with high fire ratings, etc.).

D. Demonstrate use of power fastener equipment used to fasten metal furring to masonry and other wall surfaces.

II. Students apply wood and metal furring.

FINISHING

CONTENT TITLE: Ceiling Clip Systems

SUB OBJECTIVE 9: The student will demonstrate ability to install ceiling clip system furring.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses applications of ceiling clip systems.

A. Discuss laying out ceiling clip systems. Mention that joints in attached wallboard must not lie over the furring strips as this will provide a flexure point in the system. Joints should be floated and back-blocked if desired.

B. Demonstrate attaching clips to ceiling joists. Emphasize that although nails may be used, screws are much to be preferred. Nail pop will result in squeaking clips--the ceiling will absorb some noises, but will generate noises of its own. Use nails only where it is impracticable to reach areas with screw driving equipment.

C. Demonstrate use of rubber shims where needed to ensure a good fit.

D. Demonstrate applying clips to areas where they may not be directly attached. (This involves attaching clips to a furring strip, and the strip to the joists.)

E. Emphasize necessity of maintaining specified clip spacing at all times.

F. Demonstrate installing lower runner strip in clips.

II. Students install ceiling clip system furring.

FINISHING

CONTENT TITLE: Back-Blocking

SUB OBJECTIVE 10: The student will demonstrate ability to back-block a floating joint.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses back-blocking floating joints.

   A. Mention that back-blocking is used primarily to prevent ridging in single layer applications when it is not possible to wait for desirable temperature or humidity conditions during installation.
   B. Mention that back-blocking is accomplished in regular frame-construction applications by gluing loose pieces of wallboard to the rear of the visible layer.
   C. Mention that back-blocking may also be performed using metal furring, particularly in suspended ceiling applications.

II. Instructor demonstrates back-blocking a floating joint (wood frame installation).

   A. Cut backing blocks approximately 8" wide and long enough to fit loosely between the joists.
   B. Spread joint compound over one side of blocks.
   C. Lay blocks over over-hanging edge of joint, spacing them so that they will be aligned half and half over the two pieces of the joint. Do this on end joints of applications.
   D. Align and position next piece of wallboard. Press up into place, and attach to next joint.
   E. Joints may be tapered if desired. To do this, position a strip of wood along the joint and then (while holding in place) secure with a brace attached perpendicular to the joints. This assembly should press the strip and wallboard joint upward towards the backing blocks.
   F. After compound has hardened, remove braces and wood strips. Joint may now be finished in standard manner.

III. Students attach wallboard to metal and wood furring using both manual and power application tools.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to apply wallboard for high moisture applications, and to apply predecorated and smooth-wall materials.

SOURCES OF INFORMATION

Gypsum Drywall Construction Handbook, (United States Gypsum Co.: Department 122, 101 South Wacker Drive, Chicago, Illinois 60606), 1971.

Using Gypsum Board for Walls and Ceilings, (Gypsum Association: 201 North Wells Street, Chicago, Illinois 60606), 1970.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Effects of moisture
- Moisture protective products

Communication Skills

- Manufacturer's literature
- Student Resource Manual

FINISHING

CONTENT TITLE: Water Resistant Installations

SUB OBJECTIVE 11: The student will demonstrate ability to apply wallboard around tubs, showers and other high moisture areas.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying wallboard to high moisture area.

A. Inspect framing and correct defects where necessary.
B. Apply furring as required to bring face of wallboard flush with inside lips of fixtures. Install appropriate blocking, heading and other supports for fixtures and accessories (such as towel racks, soap dishes, etc.). Do not install vapor barriers.
C. Install shower drip pans, receptors, etc. before wallboard is installed.
D. Install 1/4" spacer strips along rims of receptors, tubs, etc. to provide a space between wallboard and fixtures.
E. Apply wallboard horizontally with factory paperbound edge continguous to spacer strips. For most later tile applications, nailing should be 4" o.c., screws 8" o.c. Water resistant wallboard is preferable for these types of applications.
F. Fill all openings around fixtures, pipes, etc. with a non-hardening caulking compound. Since these cutouts are to be filled, it is advisable to make them as carefully as possible before installation. DO NOT fill 1/4" spacing around edges of tubs, showers, etc.
G. If using vinyl-coated wallboard, seal all cutouts and then caulk them. Seal all joints with vinyl tape. Be careful to maintain the moisture barrier integrity. Failure to do so will result in early failure of the installation.

II. Students apply wallboard around tubs, showers and other high moisture areas.

FINISHING

CONTENT TITLE: Predecorated Material Installation

SUB OBJECTIVE 12: The student will demonstrate ability to apply predecorated wall panels in single and double layer applications.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installation of predecorated wall panels.

A. Demonstrate mixing and matching panels to get best color match. Number panels to keep correct installation sequence.

B. Demonstrate techniques of cutting predecorated wallboard; i.e., cut vinyl with a knife and coreboard with usual tools. When using special cutout tools, work from back to avoid delaminating vinyl around openings.

C. Demonstrate application of moldings. (Note: These vary widely in design and application. Check manufacturer's recommendations for installation procedures.)

D. Demonstrate pre-bowing wallboard for installation with fasteners at end joints only. Pre-bow by suspending wallboard between stacks of 2 x 4's, built to sufficient height to give a permanent 2" bow to material. Usually, overnight will be adequate time to allow.

E. Apply predecorated material vertically, using adhesive method. Apply continuous beads of adhesive to within 6" of ends of all studs. Where joints occur, apply two beads, one for each panel, to stud. Apply wallboard quickly. Attach at short joints with matching nails, or use screws and allow room for vinyl trim.

F. Demonstrate applying predecorated materials using two layer method. Apply adhesive over entire area of backerboard using Ames spreader or notched knife. Beads should be 2" o.c. or closer, and should run to within 3" of all edges of panels. After positioning panels, strike with fist or soft rubber mallet to spread adhesive and ensure a good bond (do this at least 16" o.c.). Attach as for attaching to framing. Clean any glue from surface immediately with mild detergent. Rinse and sponge dry.

G. Apply trim moldings where necessary at top and bottom of panels, and also at unions between panels.

II. Students apply predecorated wallboard panels.

FINISHING

CONTENT TITLE: Smoothwall Installation

SUB OBJECTIVE 13: The student will demonstrate ability to install predecorated smoothwall panels.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing smoothwall panels.

A. Measure, lay out and cut panels to size.
B. Fold back vinyl flaps and tape down. Do not crease.
C. Apply adhesive bead to all framing members to be covered by panel. Run adhesive up to about 6" of end of each stud. For double layer applications, continuous beads of adhesive, running to within 3" of edges of panels, should be used.
D. Check trim to be used to ensure that it or parts of it will not have to be installed before installing panels. If this is the case, install trim and cut the loose vinyl flaps down about 3/8" so that vinyl may be pushed under trim.
E. Install panels vertically, impacting with soft rubber mallet or fist to ensure good adhesive spread and bond.
F. Float joints as in standard wallboard applications, but do not use paper tape. Use as many coats as necessary, and sand where required. Joints must be flat and level to ensure minimum visibility of vinyl seams.
G. When joints are dry, use wheat paste or latex base paste and spread over area to be covered by short vinyl flap. Use a broadknife to work bubbles out from under vinyl and to spread glue. Use moderate pressure to avoid scuffing or polishing vinyl.
H. Repeat operation on side of joint to be covered with broad vinyl flap.
I. Position a straightedge about 1/2" inside fold and use a razor type cutting tool to cut through both layers of vinyl, just to one side of joint.

Continued...

CONTENT TITLE: Smoothwall Installation (Continued)

SUB OBJECTIVE 13: The student will demonstrate ability to install predecorated smoothwall panels.

SUGGESTED ACTIVITIES: (Students and Teachers)

J. Remove trimmed strip. Lift top portion of fold and pull gently, bottom trimmed strip from under seam. Reposition first flap.

K. Use a broadknife to work vinyl into a smooth, bubble-free, tight butt joint. Remove immediately any excess paste squeezed out during the operation.

L. Roll the butt joint flat with a small roller, and then finish joint with a broad rubber roller.

M. Corners are prepared similarly, with the exception that a flap may have to be fashioned prior to wrapping it around the corner.

II. Students install predecorated smoothwall panels.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to construct and install non-loadbearing partitions and to finish columns and I-beams for fire-rated construction buildings.

SOURCES OF INFORMATION

Drywall Construction Workbook, Part 1, (California State Department of Education: 721 Capitol Mall, Sacramento, California 95814), 1969.

Gypsum Drywall Construction Handbook, (United States Gypsum Co.: Department 122, 101 South Wacker Drive, Chicago, Illinois 60606), 1971.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review math requirements for job entry and/or higher education

Science

- Fire retardant characteristics of drywall materials

Communication Skills

- Manufacturer's literature
- Engineering specifications
- Student Resource Manual
- Vocabulary development
- Review communication skill requirements for job entry and/or higher education
- Review job and career opportunities
  - Job
  - Apprenticeship
  - Higher education

FINISHING

CONTENT TITLE: Non-Loadbearing Partitions

SUB OBJECTIVE 14: The student will demonstrate ability to fabricate non-loadbearing partitions.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing wallboard in non-loadbearing partitions.

   A. Lay out partitions, ensuring that walls are parallel to other partitions and rooms laid out are true and square. Use squares or 3-4-5 method (right triangle method) to lay out room on ceilings. Transfer pattern from ceiling to floor, using plumb bobs and straightedge or chalklines to develop pattern on floor.
   B. Measure, cut and install metal runners on floors and ceilings. Installation of runners varies, and manufacturer's instructions and mating products recommendations should be followed explicitly.
   C. Prepare gypsum strips (2-1/2" and 1-5/8") for use as studs. Score and snap, or use prescored strips to prepare studding materials, and bond strips with adhesives.
   D. Attach gypsum studs to runners using power screw application equipment.
   E. Apply wallboard to runner and gypsum stud assembly, using double layer method.

II. Students install wallboard in non-loadbearing partitions.

FINISHING

CONTENT TITLE: Columns

SUB OBJECTIVE 15: The student will demonstrate ability to apply wallboard to columns or I-beams.

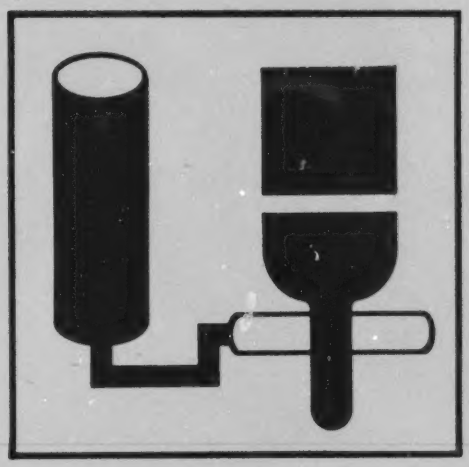
SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying wallboard to columns or I-beams.

A. Measure columns and wallboard and cut to allow each piece to overlap previous one by one board width (square basket weave pattern).
B. Abutt four pieces against walls of columns. Hold into position, or tack with adhesive.
C. Tie wire around all four positioned pieces to hold to column. Twist tight and clip twists short, pressing firmly against wallboard.
D. Apply second layer to column using screws or nails and adhesive.
E. Fabricate studding to support wallboard between sides of I's if necessary.
F. In fire-rated structures, and on most I-beam installations, apply third layer using screw and adhesive, or other acceptable method.

II. Students apply wallboard to columns or I-beams.

PAINTING AND WALL COVERING



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FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to identify by type, application, cut (when applicable) associated problems (or painting characteristics) and applicable remedial actions, the various materials or surfaces typically encountered in construction painting.

SOURCES OF INFORMATION

Cobb, Hubbard H., How To Paint Anything, (MacMillan Co.: 866 Third Avenue, New York, New York 10022), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material and tool sizing
- Ratios and proportions

Science

- Chemistry of paints
- Properties of typical surfaces

Communication Skills

- Technical reading on wood and wood products
- Student Resource Manual
- Related safety
  - Working with paints and other toxic products
  - Ladders and scaffolds
  - Ventilation
  - Fire hazards

FINISHING

CONTENT TITLE: Woods

SUB OBJECTIVE I: The student will demonstrate ability to identify by type, cut and application the basic woods used in construction which require painting.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and illustrates types of surfaces to be covered by paint.

A. Wood. Wood is a natural product which varies in a number of respects. Many types of wood are used in construction, some of which vary considerably in characteristics. Redwood and cedar are brown in color and rather uniform in grade, while pine and fir are light in color and vary considerably in grain structure.

B. Edge grain and flat grain. The methods of sawing the lumber will determine the pattern of the wood produced. If the saw cuts rapidly, facing the center of the log, it will cut directly across the growth bands forming an edge grain which shows up as parallel lines or bands. If the saw cuts at right angle to the radial line, band widths will vary considerably throughout each piece of lumber. This flat grain pattern is more interesting for furniture but less useful for painting.

C. Knots. All trees have branches which start well within the trunk; therefore, when boards are cut, especially in flat grained cuts, there will be cross sections of these branches. The cross sections are called knots.

II. Instructor identifies the following woods and their most common uses in construction.

A. Ponderosa Pine is light in color varying from creamy white to straw. Transition from springwood to summerwood is more abrupt than in white pines, but decidedly less marked than other softwoods. The wood is extremely paintable and readily lends itself to any kind of stain, lacquer or enamel.

Continued...

CONTENT TITLE: Woods (Continued)

SUB OBJECTIVE 1: The student will demonstrate ability to identify by type, cut and application the basic woods used in construction which require painting.

SUGGESTED ACTIVITIES: (Students and Teachers)

B. Idaho White Pine is light in color, varying from nearly white to a pale reddish brown. Surfaced wood presents a very subdued silken grain. This wood is a perfect base for paints, enamels and other finishes. It requires fewer coats and less repainting than most woods. Paints flow smoothly and freely and hold tightly to the surface.

C. Sugar Pine is a beautiful, soft toned creamy white wood which darkens to a pale brown, sometimes tinged with pink as it ages. The grain is indistinct; small ducts running lengthwise with the grain are common and the knots show dark purplish brown bands around their edges. Sugar Pine takes and holds paints and varnishes with a smoothness and tenacity unmatched by the softwoods. Its light color demands fewer coats than darker woods.

D. Douglas Fir. Sapwood ring is almost pure white and very narrow. Heartwood is orange-red. The color contrast between springwood and summerwood is quite distinct. Successful, long lasting paint finishes are assured when the moisture content is as close to the prevailing humidity as possible.

E. Larch. The heartwood is dark russet or reddish brown and uniformly bright and clear in color. Sapwood is straw-colored. Because of its dense and hard nature, care should be taken in the selection of the priming coat. Three coats are recommended for all new surfaces.

F. White Fir. The springwood is flat white, the summerwood has a slight reddish brown tinge. The contrast is so slight between heartwood and sapwood that these are not readily distinguishable; takes and holds paint and enamel well; well adapted to the use of stain and natural finishes.

Continued...

CONTENT TITLE: Woods (Continued)

SUB OBJECTIVE 1: The student will demonstrate ability to identify by type, cut and application the basic woods used in construction which require painting.

SUGGESTED ACTIVITIES: (Students and Teachers)

G. Engelmann Spruce is nearly white in color. The heartwood and sapwood are hard to distinguish from each other because both are so light in color. It takes enamels, stains, varnishes and most other finishes with equal ease and holds them all very well; lends itself exceptionally well to light finishes.

H. Lodgepole Pine. The sapwood is almost white; the heartwood is slightly darker and varies from a clear yellow to a pale brown, tinged with red. It takes paint well. Knot resins do not bleed, so knots require no sealing prior to finishing.

I. Incense Cedar. Sapwood is white or cream colored and the heartwood light brown or light reddish-brown. Annual rings are moderately distinct. It is classed with woods which hold paint longest and suffer least when protection against weathering becomes inadequate.

J. Western Red Cedar. The sapwood is almost pure white while the heartwood varies from a dark reddish-brown to light yellow. It takes paint, stains or varnishes readily and grips them firmly.

K. Woods most commonly used for cabinets are ash, birch and maple. These are generally stained. Pine is used for both framing and interior use such as baseboards, shoe mold and door jambs. While cedar and redwood are generally used for exterior siding, their use is determined by their availability.

III. Students identify common woods by cut, type and application.

FINISHING

CONTENT TITLE: Masonry Surfaces

SUB OBJECTIVE 2: The student will demonstrate ability to identify basic materials, list the chief problems associated with painting them and the remedies for those problems.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses different members of the masonry family.

A. Concrete, stucco, masonry and plaster. All of these have three things in common. They are hard, all contain lime and other soluble salts and are relatively porous.

B. Discuss their characteristics.

II. Instructor identifies basic problems which occur when painting masonry surfaces.

A. Surface Conditions. The surface of the new concrete or plaster may be somewhat rough and porous or very smooth and slick, depending on the type and degree of troweling used to finish the surface. Very smooth concrete can create a problem with loss of adhesion thus causing rapid flaking and peeling. The surface should be etched before painting to prevent this problem.

B. Alkalinity. Fresh concrete, mortar, stucco and plaster are highly alkaline. Alkalinity can cause premature failure of applied coatings unless they are alkali resistant. Oil paints, for example, should not be used on alkaline surfaces. The alkali will saponify the oil to form a soap which has no binding qualities. Latex and rubber base paints are not harmed by alkali in the surface.

C. Efflorescence. Concrete, stucco, masonry and plaster contain water soluble salts which dissolve in moisture carried through the substrate and then crystallize on the exposed surface. If the paint is water permeable, e.g. latex paint, the solution will pass through coating and discolor the surface in a non-uniform spotty manner. If the coating is not permeable, the salts may be deposited under the paint film and cause it to lose adhesion in spots. All efflorescence must be removed before repainting and the cause eliminated.

Continued...

CONTENT TITLE: Masonry Surfaces (Continued)

SUB OBJECTIVE 2: The student will demonstrate ability to identify basic materials, list the chief problems associated with painting them and the remedies for those problems.

SUGGESTED ACTIVITIES: (Students and Teachers)

D. Improper Cure. Improper proportioning, mixing, placing and/or curing of concrete, stucco and plaster create areas which may be of different porosity. This will result in uneven absorption of the applied coatings which show up as uneven gloss of the paint. Deterioration will also be more rapid over these areas. Subsequent reaction of the substrate with water may also cause popping of the substrate taking the coating with it.

III. Students identify masonry materials.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to identify by type, operation, characteristics and basic safety precautions applicable to use, the various paints and lacquers typically encountered in construction painting. In addition, the student will identify the basic causes of deterioration of painted surfaces.

SOURCES OF INFORMATION

Department of the Army, Paint and Protective Coatings, TM5-618, 1969. (Order from GPO, Document No. D101.11: 5-618).

Cobb, Hubbard H., How To Paint Anything, (MacMillan Co.: 866 Third Avenue, New York, New York 10022), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Chemistry of paints
- Deterioration of surfaces
- Other chemicals used in the painting or papering process

Communication Skills

- Vocabulary development
- Manufacturer's literature
- Student Resource Manual
- Related safety
  - The safe handling and storage of paint materials

FINISHING

CONTENT TITLE: Paint Characteristics

SUB OBJECTIVE 3: The student will demonstrate ability to identify by type, operation and characteristics of the basic paints (oil-based, latexes and enamels), and the basic safety considerations to be observed with each.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate and illustrate the various types of paints and lacquers.

It is very important at the onset of instruction to stress the importance of following manufacturer's recommendations, especially as to the application, mixing and storage of paints. Paints should be stored within the limits of the manufacturer's recommendations. Under no circumstances should they be exposed to excessive heat or cold. Not following manufacturer's recommendations may completely ruin a painted surface.

A. Latex paints are based on three types of emulsions. They are polyvinyl acetate, polyacrylic and polystyrene butadiene. In these paints, pigments are suspended in the non-water portion of a colloidal suspension. When the water is evaporated, a tight soluble film is formed. They have little odor, are easy to apply and dry rapidly. Interior latex paints are generally used as either primers or finish coats on interior walls and ceilings that are made of plaster or wallboard. Exterior latex paints are used directly on exteriors such as masonry or on primed wood. They are non-flammable, economical and have excellent color and color retention. Latex paint films are somewhat porous so that blistering due to moisture or evaporation is less of a problem than with solvent-thinned paints. They do not, however, adhere readily to chalk or dirty surfaces.

Continued...

CONTENT TITLE: Paint Characteristics (Continued)

SUB OBJECTIVE 3: The student will demonstrate ability to identify by type, operation and characteristics of the basic paints (oil-based, latexes and enamels), and the basic safety considerations to be observed with each.

SUGGESTED ACTIVITIES: (Students and Teachers)

B. Oil paints are the oldest type of coatings in use and have the longest history of performance. They are used primarily on exterior woods and metals since they dry too slowly for interior use. Linseed oil is the major binder in oil house paints. Oil paints come in a solid pigment as well as oil stains. Oil stains are based on a drying oil such as linseed oil in which color pigments are dispersed to a low density. In this way, maximum penetration is obtained when applied to wood. Interior stains are applied generously to sanded, dust free surfaces and allowed to dry for a short period of time. The excess is then wiped off; that portion of the stain which has penetrated the wood remains.

C. Enamels are relatively fast drying and smooth out to a hard finish. Enamels are used on woodwork due to their washability. Instructor should point out that enamels come in water-base, as well as oil-base paints.

II. Instructor discusses basic safety considerations to be observed when working with various types of paints.

A. Discuss accident problems. Painters typically work on scaffolds, on tall ladders, etc. Basic safety awareness is essential to safe working conditions.

B. Discuss fire problems. Painting often requires the use of extremely flammable compounds in the cleaning phases, and most paints are quite flammable in themselves. Fire is a constant hazard. Problems of fire are aggravated by conditions of poor ventilation. Inadequate ventilation often results in the accumulation of explosive levels of fumes which are easily ignited.

Continued...

CONTENT TITLE: Paint Characteristics (Continued)

SUB OBJECTIVE 3: The student will demonstrate ability to identify by type, operation and characteristics of the basic paints (oil-based, latexes and enamels), and the basic safety considerations to be observed with each.

SUGGESTED ACTIVITIES: (Students and Teachers)

C. Discuss health hazards. Cleaning compounds such as solvents, acids or alkali cleansers are usually corrosive and irritating to skin and mucous membranes. They are usually very harmful to eyes. High pressure abrasives and water blasting techniques represent equal health hazards. Inadequate ventilation often results in accumulation of fumes which are toxic and can be seriously harmful to the painter's health.

III. Instructor discusses weather factors in painting.

A. Discuss effects of low temperatures on paint operation. Point out that low temperatures thicken paint and make them very difficult to apply. Moreover, they prevent smooth leveling and retard drying.

B. Discuss effects of high temperatures on paint operation. Point out that high temperatures cause paint to tend to sag and set up too rapidly. This results in lap marks and may even result in wrinkling and loss of adhesion under extreme circumstances.

C. Discuss effects of humidity on paint operation. Point out that humidity, dampness and frost retard drying time and are common causes of blistering and poor adhesions.

IV. Students identify paints by type and identify basic factors affecting their operation.

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 4: The student will demonstrate ability to identify the causes of deterioration of old painted surfaces.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses causes and effects of normal deterioration of paints. The student should note that paints are not indestructible. Even properly selected protective coatings, properly applied on well-prepared surfaces will gradually deteriorate and eventually fail.

A. Discuss soiling. Outline basic sources of soiling and areas most subject to this problem (such as under overhangs, and other areas protected from washdown). Note that dirt pickup is greater with softer paints such as linseed oil-base paints and is more visible on light colors. It is less noticeable on chalking paints.

B. Discuss color changes. Many colors, especially bright ones, fade and turn dull with time. Tinted paints become more pale. Fading is aggravated by chalking since the chalk produces generally white or lighter-than-mass colors. Enamels and latex paints fade less rapidly than softer, linseed oil paints. White paints, especially those based on linseed oil, will yellow in areas protected from sunlight.

C. Discuss flattening. Gloss paints lose their gloss and eventually turn flat with age. This is the initial breakdown of the vehicle at the surface of the paint. Loss of gloss is soon followed by chalking. The second stage of normal deterioration occurs after continued exposure. The coating begins to breakdown first at the surface, then, unless repainted, gradually through the coating and down to the substrate. There are two types of deterioration which may take place (1) chalking, (2) checking and cracking. The degree of either depends on the type of paint and the severity of exposure. Chalking is the result of weathering of the paint at the surface of the coating. The vehicle is broken down by sunlight and other destructive influences, leaving behind loose powdery pigments which can easily be rubbed

Continued...

CONTENT TITLE: Preparation (Continued)

SUB OBJECTIVE 4: The student will demonstrate ability to identify the causes of deterioration of old painted surfaces.

SUGGESTED ACTIVITIES: (Students and Teachers)

off with the finger. Chalking takes place more rapidly in areas exposed to large amounts of sunlight. Checking and cracking are described as breaks in the paint film which are formed as the paint becomes hard and brittle. Temperature changes cause the substrate and overlying paint to expand and contract. As the paint becomes harder, it gradually loses it ability to expand without flaking. Checking is described as tiny breaks which take place only in the upper coats of paint film without penetrating to the substrate.

D. Paint coatings exposed in humid climates or in warm, damp rooms may be attached by mildew, a fungus which feeds on the coating. Mildew will grow and become quite unsightly and eventually will accelerate the deterioration of the coating. In its early stages it looks like dirt but cannot be easily washed off. The presence of mildew can be determined by use of household bleach which will bleach mildew, but will not effect dirt. Hard drying paints such as enamels or paints containing zinc oxide are more resistant to mildew. Especially formulated moisture and mildew resistant paints should be used in those areas exposed to severe moisture.

II. Students identify the causes and effects of normal deterioration of painted surfaces.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to inspect and erect ladders and scaffolding.

SOURCES OF INFORMATION

Department of the Army, Paints and Protective Coatings, TM5-618, 1969. (Order from GPO, Document No. D101.11:5-618.).

Cobb, Hubbard H., How to Paint Anything, (MacMillan Co.: 866 Third Avenue, New York, New York 10020), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Related safety
  - Ladders and scaffolds
  - Falls
- Student Resource Manual
- Manufacturer's literature
- Blueprint reading and symbols

FINISHING

CONTENT TITLE: Auxiliary Equipment

SUB OBJECTIVE 5: The student will demonstrate ability to safely erect ladders.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses ladders.

A. Wooden ladders should always be stored in a warm dry area, protected from the weather and ground. Protect wooden ladders with clear coatings only, so that cracks, cracking and splintering and other defects will be readily visible. Inspect all ladders frequently for loose or bent parts, cracks or breaks or splinters.

B. All straight and extended ladders must have safety shoes. These should be of insulating materials on metal ladders. Do not use portable ladders greater in length than can be readily carried and placed by two people. It should be stressed never to splice to form a longer ladder. Extension ladders should have a minimum overlap of 15 percent for each section. Do not use step ladders over 10 feet high. Never use an extension ladder as a straight ladder; never stand on the top platform.

II. Instructor demonstrates erecting ladders.

A. Place ladders so that horizontal distance from top support to foot is at least one fourth of the working length.

B. Ensure that ladder is securely in place.

C. Rope off all doorways in front of ladder and place warning signs.

D. Use hand lines to raise and lower materials and tools.

E. Do not over-reach when working on ladders; move ladder instead.

F. Avoid using metal ladders when contact with electrically charged conductors is possible.

III. Students erect ladders.

FINISHING

CONTENT TITLE: Scaffolding

SUB OBJECTIVE 6: The student will demonstrate ability to inspect and erect scaffolding.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses scaffolding.

A. Outline different types of scaffolding, including double pole independent, diagonal bracing types. Mention single pole scaffolding, corner construction scaffolding, horse, outrigged, swing and ladder platform scaffolding.
B. Discuss pipe scaffolding. Include regular pipe type, roller outrigger type and one man assembly type.
C. Discuss boatswain (pronounced boson) chair and swing scaffolding.

II. Instructor demonstrates inspecting and erecting scaffolding.

A. All metal should be checked for damage or corrosion.
B. All wooden parts should be checked for defects such as checks, splits, unsound knots and decay.
C. Ensure that adequate sills or underpinning is provided when erecting scaffolding on fill or soft ground.
D. Ensure that scaffolding is plumb and level. Compensate for unevenness of ground by blocking or using adjusting screws.
E. Anchor scaffolding to wall about every 28 feet (length) and every 18 feet (height).
F. Never force braces into position. Use horizontal and diagonal bracing at top and every 30 feet (height).
G. Lumber should be straight grained, and all nails should be driven to full length and not subject to direct pull.
H. Provide guard railings regardless of height along full length of scaffolding and at ends.
I. Erect scaffolding so that ladders are lined up from top to bottom. Always use ladders when climbing.

III. Students erect and inspect scaffolding.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to fill cracks and crevices and prepare various types of surfaces for later application of paints. Moreover, the student should demonstrate ability to prepare paints for application by mixing and boxing.

SOURCES OF INFORMATION

Department of the Army, Paints and Protective Coatings, TM5-618, 1969. (Order from GPO, Document No. D101.11:5-618).

Cobb, Hubbard H., How to Paint Anything, (MacMillan Co.: 866 Third Avenue, New York, New York 10022), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Material grading and sizing
- Mixing ratios

Science

- Surface preparation and products used

Communication Skills

- Working drawings
- Student Resource Manual
- Manufacturer's literature
- Catalog work and material pricing

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 7: The student will demonstrate ability to prepare surfaces for painting.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing surfaces for painting.

A. Point out that the most essential part of any painting job is the proper surface preparation. Paint will not adhere well, provide the required protection nor have the desired appearance unless the surface has been properly prepared.

B. Discuss selection of sanding agents. All new wood should be sanded smooth with 1/0 or 2/0 sandpaper. Use #1/0 first on rough spots.

C. Demonstrate use of steel wool. Use fine steel wool (00 or 000) on rounded or irregular surfaces.

D. Demonstrate removing loose paint by scraping and sanding carefully with coarse sandpaper such as #2/0.

E. Demonstrate removing loose paint using paint and varnish remover. After removing old coating, sand as for a new surface.

F. Emphasize that all surfaces must be thoroughly cleaned.

G. Be sure that students are capable of safely operating scrapers, brushes, power tools, electric sanders (and for metal, grinders) and different types of flame cleaning equipment.

II. Students prepare a surface for painting.

FINISHING

CONTENT TITLE: Caulking

SUB OBJECTIVE 8: The student will demonstrate ability to apply gun-grade caulking compound to fill joints and crevices and to putty recessed nails.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying caulking compounds.

A. Move gun along crevice while triggering so that compound is extruded directly into crevice.
B. Move gun slowly and steadily so to push bead into crevice rather than pull it away.
C. Allow compound to overlap opening slightly for better sealing and to allow insignificiant surface area for adhesion.
D. Gun should be held at a slight angle with bevel parallel to work.
E. Compound should be finely tooled to ensure close contact with surface joint.

II. Instructor demonstrates covering nail heads with putty after primer coat has dried.

A. Squeeze putty into hole with putty knife.
B. Cut off putty with knife, while keeping material under pressure.
C. Ensure that surface is slightly convex to allow for shrinking.
D. Remove all oil, grease spots, loose paint or dirt on old material. Emphasize that all surfaces should be clean and dry to obtain good adhesion.

III. Students apply gun-grade caulking compounds to fill joints and crevices and putty recessed nails.

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 9: The student will demonstrate ability to prepare new and existing surfaces for application of paint.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparation of interior for new and existing wood surfaces.

A. Some of the most common interior surfaces a painter will be faced with are wood, metals, concrete, masonry, plaster and wallboard, hardboard, compressed board and particle board.

B. Some of the types of surface repair material used will be putty, glazing compound, patching plaster, spackling joint cement and plastic wood. All woods should be sanded down, if new, with fine sandpaper, preferably around 180 mesh.

C. The preparation of new woods, such as door jambs, which will be enameled should be either brushed or sprayed with undercoating. The undercoating should be the same brand as the enamel.

D. After undercoating has taken place, all cracks, nail holes and crevices should be caulked and puttied. The first coat of enamel should be applied. Allow to dry for 48 hours and apply second-coat.

II. Instructor demonstrates preparing plaster surfaces for painting.

A. All new plaster should be allowed to age at least 30 days before painting with oil-base paints. Latex paints can be applied after 48 hours. Small cracks or holes should be filled with spackle.

Continued...

FINISHING

CONTENT TITLE: Preparation (Continued)

SUB OBJECTIVE 9: The student will demonstrate ability to prepare new and existing surfaces for application of paint.

SUGGESTED ACTIVITIES: (Students and Teachers)

B. Large openings and deep holes should be filled with patching plaster. Allow 4 hours for spackle and plaster to dry, and 24 hours for joint cement.

C. Sand smooth before painting. In working with old work, remove all loose or scaling paint and sand lightly. Wash off all dirt and oil stains and allow to dry, thoroughly.

III. Students prepare new and existing surfaces for application of paint.

FINISHING

CONTENT TITLE: Boxing

SUB OBJECTIVE 10: The student will demonstrate ability to box paint.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates boxing paint.

A. First point out that paint tends to settle during storage. To be sure units are uniform, paints should be boxed before use.

B. Start with two one-gallon cans, one with paint and one without. First pour off the thin portion into a clean container.

C. Stir the settled paste, breaking up lumps, if any, using 1-1/2" paddles for one-gallon cans. Mix thoroughly using a figure 8 motion, following with a lifting and beating motion. Continue to stir while gradually returning the poured off portion to the original container.

D. Box paint by pouring several times back and forth, from one container to another until paints are uniform.

II. Students box paint.

FINISHING

OVERALL OBJECTIVE: Given prepared surfaces with which to work, the student will demonstrate ability to apply smooth, even coats of paint using brush, roller and spray methods.

SOURCES OF INFORMATION

Department of the Army, Paints and Protective Coatings, TM5-618, 1969. (Order from GPO, Document No. D101.11:5-618).

Cobb, Hubbard H., How to Paint Anything, (MacMillan Co.: 866 Third Avenue, New York, New York 10022), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Pressures

Science

- Theory of spray painting

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Related safety
  - Proper usage of power spraying equipment

FINISHING

CONTENT TITLE: Brush Application

SUB OBJECTIVE 11: The student will demonstrate ability to paint a room using brush application method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates brush application techniques.

A. Dip brush into paint up to 1/2 bristle length. Then withdraw and tap against the inside of the bucket to remove excess paint.

B. Hold the brush at 45° angle to the work. Make several short strokes in the area to be painted. This will transfer much of the paint to the surface. Then spread the paint evenly and uniformly. Do not bear down on the brush. When one section of the surface is painted, adjacent areas should be painted so brush strokes are completed by sweeping the brush into the wet edge of the paint previously applied to the section. This helps eliminate lap marks and provides more even coating.

C. Finally, cross brush lightly to smooth the painted surface and eliminate brush or sag marks. Fast drying paints will not permit brushing and cross lapping. In such cases the paint should be applied, spread rapidly and then allowed to dry undisturbed.

II. Instructor demonstrates steps in painting a room.

A. Start major work on the topmost area first, such as ceilings of the room, then work downward, painting walls downward to the floor.

B. Begin painting at the corner, work downward painting section to the floor or ground, then start at the top of adjacent areas and work downward again.

Continued...

FINISHING

CONTENT TITLE: Brush Application (Continued)

SUB OBJECTIVE 11: The student will demonstrate ability to paint a room using brush application method.

SUGGESTED ACTIVITIES: (Students and Teachers)

C. Paint trim, doors, windows or other small areas after walls, ceilings and major surfaces are completed.
D. Corners and edges are always painted so that stroke is completed by sweeping off the corner or edge.
E. Always avoid poking brush into corners and crevices. Instead, use the edge of the brush and twist it slightly if necessary to cover rough surfaces.

III. Students paint a room using brush application method.

FINISHING

CONTENT TITLE: Roller Applications

SUB OBJECTIVE 12: The student will demonstrate ability to select rollers and use them to apply a smooth, even coat of paint to a room.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses types of rollers and their uses.

A. A paint roller consists of a cylinder cover which slips onto a rotatable cage to which a handle is attached. The cover may be 1/2 to 2-1/2" in diameter and is usually 3, 4, 7 or 9" in length. Special industrial length rollers run generally 1-1/2" to 18". Proper roller application depends on the specific job that is to be done. Selection of fabric and thickness of fabric or nap length is based on the type of paint and smoothness of the surface to be painted.

B. There are special rollers for special paint jobs such as painting pipes, fences and other hard-to-reach areas. The fabric most commonly used is lambs wool. This is a most solvent resistant type of material and is available in nap lengths up to 1-1/2". It is generally used for synthetic finishes as it mats badly in water and is not recommended for water paints.

C. Mohair is made primarily of Angora goat's hair. It is also solvent resistant and is supplied in 3/16" to 1/4" nap lengths. It is recommended for synthetic enamels and for use on smooth surfaces; may be used with water-base paints.

D. Dynel is a modern acrylic fiber which has excellent resistance to water. It is best used for application of conventional water paints and solvents. It is available in all nap lengths from 1/4" to 1-1/4". Dacron, a synthetic fiber somewhat softer than Dynel, is best suited for exterior oils or latex paints. Nap lengths from 5/16" to 1/2" are available in Dacron.

Continued...

CONTENT TITLE: Roller Applications (Continued)

SUB OBJECTIVE 12: The student will demonstrate ability to select rollers and use them to apply a smooth, even coat of paint to a room.

SUGGESTED ACTIVITIES: (Students and Teachers)

E. Rayon is not recommended for any application because of poor results generally obtained from its use. Results are poor with solvent paints and it mats in water to be of value in use with water-base paints.

F. Rollers are used with trays or screens attached to cans; also available are fountain-pen type rollers wherein paint is contained inside the roller and self-loading types wherein paint is supplied via pressurized pumping systems.

II. Instructor demonstrates application of paint by roller method.

A. First fill tray about 1/2 full.

B. Immerse roller completely, then roll it back and forth along the ramp to fill the cover completely and remove any excess paint. As an alternative, place a specially designed galvanized screen into a 5 gallon can of paint. The screen attaches itself to the can and remains at the correct angle for loading and spreading the paint onto the roller.

C. The first load of paint should be worked out on a newspaper to remove any trapped air from the roller. It is then ready for application. As the roller passes over the surface the fibers continue compressing and expanding, mattering out the coat and wetting the surface.

D. Always trim around ceilings and molding before rolling major wall or ceiling surfaces. Roll as close as possible to maintain the same texture. Trimming is usually done with a 3" wall brush. Always roll paint onto a surface working from the dry area into the just rolled area. Never completely roll in the same direction; don't roll too fast, and avoid spinning the roller at the edge of the stroke.

E. Always feather out strokes and pick up excess paint on the surface. This is accomplished by rolling the final stroke with minimum pressure.

III. Students paint a room using rollers.

FINISHING

CONTENT TITLE: Spray

SUB OBJECTIVE 13: The student will demonstrate ability to adjust, operate and clean spray equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses types of spray equipment.

A. In a conventional sprayer the paint is placed in a closed container called a pot. The introduction of air pressure from a compressor forces the material through the hose to the spray gun. The gun is connected to a separate hose. At the gun the material is atomized by air supplied through the central opening of the air cap. This has been for years the most common spray technique, but it tends to create excessive overspray because of the high ratio of air to paint used. Small jobs are sprayed with guns which can be attached to quart jars of paint from which paint is fed to the gun either by pressure or by vacuum.

B. The airless spray uses hydraulic pressure. Equipment is similar to conventional spray equipment, except that pressures are much higher. Atomizing is accomplished by forcing the material through a special shaped diaphragm at pressure between 1500 and 3000 pounds per square inch. These pressures produce a high speed stream of paint at the orifice. When the paint leaves the orifice, the release of the pressure causes the paint to atomize. There is no air turbulence to direct the paint in this system and rebound is greatly reduced--thus a more uniform coverage is possible with this type of system.

II. Instructor demonstrates controlling the various operating parameters of spray equipment.

A. Viscosity of the paint: It must be low enough to permit proper atomization but high enough to apply without running or sagging. Generally, a trial and error approach is required.

B Pot pressures: This determines the amount of material forced through the nozzle. Pot pressures are controlled at the air regulator gun.

Continued...

CONTENT TITLE: Spray (Continued)

SUB OBJECTIVE 13: The student will demonstrate ability to adjust, operate and clean spray equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

C. Atomizing process: This is the air pressure supplied to the gun to atomize the material and produce a uniform wet film. Too much pressure here will cause excessive overspray or dry spray. Too little pressure produces a speckled or dimpled effect.

D. Air cap on spray gun: This controls the amount and distribution of air mixed with the coating at the gun. The amount of air and air pressure controls atomization while the distribution of the air determines the shape of the spray pattern.

E. Material orifice (nozzle): The size of this opening controls the amount of material that can be passed through the gun.

F. Air and material controls on gun: These are for rough adjustment of amount delivered.

Note: Adjust paint viscosity only when necessary and then according to manufacturer's instructions. Excessive thinning results in needless overspray, excessive runs and sags, poor hiding and inferior surface protection. During application, use the lowest material and air pressures that result in quality finish with good flow out.

Material pressure is best adjusted starting at the point where a solid stream of paint will flow out about 24" from the gun with the atomization air turned off. When the material is heavy and viscous, when the fluid hose is extra long, or when a more rapid rate of application is required, it will be necessary to also increase the air pressure since it is important to maintain a proper ratio of material-pressure-to-atomizing-air-pressure. There is no set rule for spray gun pressures because they will vary with the nozzle used, the paint used and surface to be coated. To reduce overspray, use the minimum pressure necessary.

Continued...

FINISHING

CONTENT TITLE: Spray (Continued)

SUB OBJECTIVE 13: The student will demonstrate ability to adjust, operate and clean spray equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

III. Instructor demonstrates applying paint with spray equipment.

A. Adjust the spray pattern. Spray width adjustment screw is turned clockwise for a round pattern and counter-clockwise for a fan pattern. Turn the material control screw clockwise to increase the flow. As the width of the pattern is increased, increase the flow of paint to maintain the same coverage over a wider area.

B. Keep the spray gun 6" to 10" from the surface to be coated. Holding the gun too far away causes "dusting" in which the paint solvent evaporates in midair and the coating hits the surface in a nearly dry state.

C. Keep gun perpendicular to surface. Tilting the gun causes the paint to be more heavily applied on one area of the spray pattern than another. Use a free-arm motion moving parallel to surface at all times and feather out at the end of the stroke by pulling the gun trigger after beginning the stroke and releasing it before the stroke is completed. When spraying corners, stop 1" to 2" short of the corner. Then hold the gun so as to sweep up and down along the edge of the corner and hit both sides at the same time.

IV. Instructor demonstrates cleaning spray equipment.

A. Emphasize that it is absolutely essential that all tools and equipment be cleaned thoroughly, immediately after use and before paint materials have a chance to get hard. Remove as much paint as possible, then clean thoroughly with a compatible solvent. Clean two or three times in fresh solvent until no paint is noticeable. Wipe clean and dry. With good care, all tools and equipment will last much longer and will always be in prime condition for use.

Continued...

CONTENT TITLE: Spray (Continued)

SUB OBJECTIVE 13: The student will demonstrate ability to adjust, operate and clean spray equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

B. Spray equipment should be cleaned thoroughly by placing clean solvent in pots and passing it through hoses and guns. When clean, empty, wipe clean and dry. Clean pots separately. Use extreme care when cleaning airless spray guns inasmuch as the high pressures involved are hazardous. Make sure that all systems are depressurized before opening anything.

V. Students operate spray equipment to paint a room.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to prepare surfaces for and paper a room.

SOURCES OF INFORMATION

None

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Estimating wall covering
- Review entry requirements for job and/or higher education

Science

- Types and properties of various wall coverings
- Adhesives and sizing

Communication Skills

- Student Resource Manual
- Catalog and sample usage
- Related safety
  - Ladders and platforms
  - Steamers
  - Power equipment
- Review entry requirements for job and/or higher education
- Review job and career opportunities in painting and wall covering industries
  - Job
  - Apprenticeship
  - Higher Education

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 14: The student will demonstrate ability to prepare wall surfaces for papering.

SUGGESTED ACTIVITIES (Students and Teachers)

I. Instructor demonstrates preparing wall surfaces for papering.

   A. Demonstrate using a steamer to remove excess paper when old paper is not firm.
   B. Emphasize that when papering over old paper, seams must be sanded smooth.
   C. Demonstrate removing old paper by soaking with warm water and scraping off with a broadknife.
   D. Remove all dirt or grease from wallboard or plaster surfaces. Note that in drywall construction, excessively wetting paper should be avoided.
   E. Clean painted surfaces and sand all enamel, semi-gloss or glossy surfaces.

II. Students prepare wall surfaces for papering.

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 15: The student will demonstrate ability to mix size and paste.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates mixing size and paste.

A. Emphasize necessity for absolute cleanliness.
B. Demonstrate measuring dry ingredients.
C. Demonstrate measuring wet ingredients.
D. Mix ingredients following manufacturer's specifications. Demonstrate mixing by hand and the use of power equipment.
E. Discuss use of sizing; i.e., that sizing will usually aid in visualizing those areas likely to require further preparation before final papering operations are done.

II. Students mix sizes and pastes.

CONTENT TITLE: Papering

SUB OBJECTIVE 16: The student will demonstrate ability to apply plain wallpaper to a previously prepared wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates papering a wall.

A. Remove wall plates from electrical fixtures. Stress safety considerations. Ensure that power is switched OFF at the box, and that the switch box is appropriately labeled.

B. Ensure that all wall surfaces are prepared.

C. Strike a plumb line to ensure that paper will run along straight, vertical lines. Start at a prominent part of the room such as near a door or window.

D. Measure distance from ceiling to baseboard (or floor as necessary).

E. Cut as many full length strips as necessary to complete a run. Cut, allowing enough material to overlay ceiling and floor edges and following manufacturer's recommendations for matching patterns.

F. Place paper, face down, on paste table and apply a thin coat of paste to the back of the sheet. Apply using either roller or brush, but ensure that coating is uniform and runs smoothly out to the edge.

G. Fold (but do not crease) sheet to bring pasted surfaces together. If necessary, sheet may be doubled over again. This is done to facilitate carrying and working with the paper.

H. Working from top down, start hanging first strip. Ensure that strip's edge is aligned with plumb guide line.

I. Brush upper portion of strip into place and continue unfolding bottom half of paper. Brush out all bubbles. This is the most important part of the job, so time spent in extra careful alignment and installation is needed.

Continued...

CONTENT TITLE: Papering (Continued)

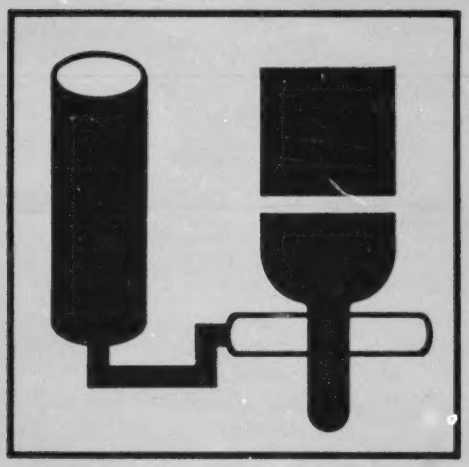
SUB OBJECTIVE 16: The student will demonstrate ability to apply plain wallpaper to a previously prepared wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

J. Position next sheet, matching patterns at top. Install as before.
K. After joining strips, remove any excess paste from paper and joints. Use a clean sponge.
L. Remove excess paper from bottom of sheet using a straight-edge and a razor blade or cutting wheel.

II. Students paper a room.

GLASS AND GLAZING



FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to cut glass for, and to install, a window pane.

SOURCES OF INFORMATION

Berlye, Milton K. The Encyclopedia of Working with Glass, (Oceana Publications, Inc.: Dobbs Ferry, New York), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material sizing

Science

- Properties of glass

Communication Skills

- Student Resource Manual
- Vocabulary development
- Related safety - working with glass

FINISHING

CONTENT TITLE: Window Glazing

SUB OBJECTIVE 1: The student will demonstrate ability to measure and cut a sheet of glass to form a window pane of predetermined size.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses glass-cutting procedures.

II. Instructor demonstrates cutting glass.

- A. Brush the glass to be cut with clean cloth.
- B. Lay the glass on a flat table or on layers of newspaper.
- C. Brush kerosene along the line to be cut.
- D. Oil the glass cutter with sewing machine oil.
- E. Dampen bottom of straightedge and lay it along line to be cut.
- F. Grasp cutter between first and second fingers.
- G. Hold cutter upright with thumb on backside.
- H. Begin 1/8" from farthest edge of glass and run cutter along straightedge to make a firm, even, continuous fine hair-line.
- I. Hold glass firmly and evenly on both sides close to the cut; bend the glass and break it.
- J. Nip away any uneven edges with glass pliers.

III. Students cut glass.

FINISHING

CONTENT TITLE: Window Glazing

SUB OBJECTIVE 2: The student will demonstrate ability to clean and prepare a sash for glazing.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates cleaning and preparing a sash for glazing.

   A. Remove all oil, dirt, old putty and glazing points and fragments of broken glass.
   B. Use tape measure or glazing rule to measure the light--length and width.
   C. Allow tolerance of 1/16" to 1/8".
   D. Lay out the dimensions of the pane on the plate to be cut.
   E. Cut the pane.

II. Students clean and prepare sash for glazing.

FINISHING

CONTENT TITLE: Window Glazing

SUB OBJECTIVE 3: The student will demonstrate ability to install a window pane in a sash.

(Students and Teachers)

I. Instructor discusses installing a window pane.

II. Instructor installs window pane.

A. Apply continuous ribbon of bedding compound to rabbet with either hand or air-operated bedding gun.
B. Press pane into glass with equal pressure on all four edges.
C. Apply at least 4 glazing points per pane and install them with a glazer's hammer.
D. Apply putty to the front of the pane.
E. Smooth the putty with a putty knife so that it forms a triangle shaped fillet whose top is 1/16" below line of sight.
F. Make contours smooth.
G. Remove excess putty.

III. Students install window pane.

FINISHING

CONTENT TITLE: Window Glazing

SUB OBJECTIVE 4: The student will demonstrate ability to install a window pane using wood stop glazing.

SUGGESTED (Students and Teachers)

I. Instructor demonstrates installing a window pane using wood stop glazing.

   A. Apply ribbon of bedding compound with a bedding gun.
   B. Press glass pane into place using firm, even pressure on all four edges; if glass has bowed, install with concave side in.
   C. Apply front bead of glazing compound and smooth with a putty knife.
   D. Attach carefully measured and cut wood stops to the outside of the pane.
   E. Attach stops with small nails or wire brads and 8 ounce or 10 ounce hammer.

II. Students install window pane using wood stop glazing.

FINISHING

CONTENT TITLE: Window Glazing with Wooden Sashes

SUB OBJECTIVE 5: The student will demonstrate ability to prepare a new wooden sash for glazing.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing a new wooden sash for glazing.

   A. Make sure the sash is clean and dry.
   B. Apply coat of primer paint to sash. (Do not use varnish or shellac; glazing compounds will not adhere to it.)
   C. Let primer coat dry.

II. Students prepare a new wooden sash for glazing.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to install a pane of glass in a metal sash using a variety of techniques.

SOURCES OF INFORMATION

"The Care and Repair of Aluminum Doors and Windows," Mechanix Illustrated, (May, 1971), pp. 115-116, 136-137.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Tool and equipment sizing

Communication Skills

- Manufacturer's literature
- Student Resource Manual

FINISHING

CONTENT TITLE: Window Glazing with a Metal Sash

SUB OBJECTIVE 6: The student will demonstrate ability to install a pane of glass in an aluminum window using clips.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing glass in metal sash with clips.

A. Snap out the metal clips holding pane to the sash.
B. Do not kink the clips or the sash.
C. Remove any fragments of broken glass with tweezers.
D. Scrape off the old sealant with cloth and razor blades.
E. Apply silicone rubber or polysulfide caulking evenly around the sash with a brush or small wooden paddle.
F. Trim away excess sealant.
G. Press pane into place.
H. Snap clips back in.
I. Remove excess sealant with a razor blade tool.

II. Student installs glass in metal sash with clips.

FINISHING

CONTENT TITLE: Window Glazing with a Metal Sash

SUB OBJECTIVE 7: The student will demonstrate ability to install a window pane with screw-on moldings.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing a window pane in a sash with screw-on moldings.

   A. Remove the moldings with a Phillips No. 2 screwdriver.
   B. Remove any remaining fragments of glass with tweezers.
   C. Scrape off old sealant with cloth or razor blade tool.
   D. Apply silicone rubber or polysulfide sealant around the rim with a brush or small wooden paddle.
   E. Press pane into place.
   F. Replace moldings.

II. Students will install a window pane in a sash with screw-on moldings.

FINISHING

CONTENT TITLE: Window Glazing with Metal Sashes

SUB OBJECTIVE 8: The student will demonstrate ability to install a new pane in a sash with rubber or vinyl wrap-around gaskets.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing a pane in a window with rubber or vinyl wrap-around gaskets.

   A. Remove the frame.
   B. Remove the screws which hold the frame together.
   C. Remove the gasket.
   D. Remove the fragments of broken glass with a pair of tweezers.
   E. Press the new pane into place.
   F. Replace the gasket.
   G. Replace the screws.
   H. Replace the frame.

II. Students install a pane in a metal sash with a rubber or vinyl wrap-around gasket.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to install a bathroom mirror using a variety of methods.

SOURCES OF INFORMATION

FGMA Glazing Manual, (Flat Glass Marketing Association: 1325 Topeka Avenue, Topeka, Kansas 66612).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Level, plumb and square
- Computing square feet

Science

- Mirror construction

Communication Skills

- Vocabulary development
- Student Resource Manual
- Manufacturer's literature
- Related safety - handling and lifting large pieces of glass

FINISHING

CONTENT TITLE: Bathroom Mirror Glazing

SUB OBJECTIVE 9: The student will demonstrate ability to install an unframed mirror with mastic.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses methods of hanging mirrors.

II. Instructor demonstrates hanging a bathroom mirror with mastic.

A. Paint the back of the mirror with water-resistant paint.
B. Let paint dry.
C. Measure the bottom edge of the mirror.
D. Attach a channel support to the wall the length of the mirror bottom with screws, nails or toggle bolts.
E. Apply mastic to 1/3 of the back surface of the mirror with putty knife or wooden paddle.
F. Press mirror to the wall; make sure the mirror rests evenly along the channel.

III. Students hang a bathroom mirror with mastic.

FINISHING

CONTENT TITLE: Bathroom Mirror Glazing

SUB OBJECTIVE 10: The student will demonstrate ability to install a mirror using double-faced tape.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses using double-faced tape to hang a mirror.

   A. Be sure tape is compatible with mirror backing.
   B. Be sure tape is 1/8" thick.
   C. Use tape whose adhesive capacities are one pound per 1/2 square inch of tape.

II. Instructor demonstrates hanging a mirror with double-faced tape.

   A. Weigh the mirror.
   B. Calculate the amount of tape necessary to support it.
   C. Measure the bottom edge of the mirror.
   D. Install clips or a channel along the bottom of the mirror.
   E. Cut the number of strips necessary to hold the mirror in place and trim the top end to a point to allow moisture to drain away.
   F. Attach the tape in vertical strips.
   G. Attach the mirror to the wall. Be sure the mirror rests evenly in the channel or clips.

III. Student hangs a mirror with double-faced tape.

FINISHING

CONTENT TITLE: Mirror Glazing

SUB OBJECTIVE II: The student will demonstrate ability to hang a mirror using rosettes or screws.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses hanging a mirror with rosettes or screws.

   A. Make sure the holes in the mirror are 1/8" larger than screw diameter.
   B. Mirrors 10 square feet or less need four screws, one at each corner 4" from edge.
   C. Use toggle bolts on plaster.

II. Instructor demonstrates hanging a mirror with bottom channel and clips.

   A. Install a felt or rubber sleeve to prevent direct contact between the glass and the screw.
   B. Install a felt washer behind the screw head.
   C. Do not tighten screw too tightly.

III. Students will apply screws to mirror.

FINISHING

CONTENT TITLE: Mirror Glazing

SUB OBJECTIVE I2: The student will demonstrate ability to mount a mirror on a skeleton wood back.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate mounting a mirror on a skeleton wood back.

   A. Measure length and width.
   B. Cut pieces of 3/4" by 1-3/4" board the length of the mirror.
   C. Place the wood carefully so the bottom edge of the bottom piece and the top edge of the top piece are even with the edges of the mirror.
   D. Attach the wood with countersunk screws or toggle bolts.
   E. Paint the face and edges of the wood to match the surrounding wall surface.
   F. Attach wood or plastic clips to the lower edge of the wood panel and to the top panel on the sides 4" below the top edge of the mirror with screws.
   G. Place felt cushions between the clips and the mirror face and attach the mirror.

II. Students mount a mirror on a skeleton wood back.

FINISHING

CONTENT TITLE: Mirror Glazing

SUB OBJECTIVE I3: The student will demonstrate ability to mount a mirror with bottom channel and clips.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate mounting a mirror with bottom channel and clips.

   A. Measure carefully the bottom edge of the mirror with a tape measure.
   B. Cut a channel of metal or wood the length of the bottom edge.
   C. Mount the channel with screws or toggle bolts.
   D. Attach clips half way up the vertical length of the mirror and the horizontal length of the mirror.
   E. Paint the bottom edge of the mirror to protect it from moisture.
   F. Place the mirror in position.
   G. Place felt pads between the mirror and the clips.

II. Students mount a mirror with bottom channel and clips.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to install a plate glass window using a variety of techniques.

SOURCES OF INFORMATION

None

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Glass expansion contraction
- Stress and shocks

Communication Skills

- Related safety
  - Transporting large glass sheets
  - Safety equipment

FINISHING

CONTENT TITLE: Plate Glass Windows

SUB OBJECTIVE 14: The student will demonstrate ability to prepare the metal sash of a storefront for glazing.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will discuss preparing a storefront sash for glazing.

II. Instructor will demonstrate preparing a metal storefront for glazing.

   A. Measure the framing on the window.
   B. Compare actual measurements to the indicated measurements on the blueprints.
   C. Remove or fasten down rivets, bolts, screw heads and other impediments in the rabbets.
   D. Apply a coat of primer paint to the glazing channel.

III. Students prepare a sash for glazing.

FINISHING

CONTENT TITLE: Plate Glass Windows

SUBOBJECTIVE 15: The student will demonstrate his ability to set plate glass in a prepared sash using metal stops and neoprene gaskets.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation of plate glass windows using metal stops and neoprene gaskets.

II. Instructor demonstrates installing plate glass windows using a neoprene gasket.

A. Measure the glazing channel.
B. Measure off the necessary length of neoprene gasket material.
C. Fit the gasket material to the glazing channel; begin in the upper left hand corner and work downward.
D. Attach two or more vacuum cups to the precut sheet of plate glass.
E. Lift the glass into a vertical position.
F. Slip the glass into one vertical channel of the glazing frame as far as it will go.
G. Swing the glass around so that it clears the opposite edge of the channel.
H. Set neoprene setting blocks at quarters at the bottom of the glazing frame.
I. Rest the glass on the setting blocks.
J. Remove the vacuum cups.
K. Fit the inner seal of the gasket around the glazing frame--begin at the upper left hand corner and work counterclockwise.

III. Student installs plate glass window using neoprene seal.

FINISHING

CONTENT TITLE: Plate Glass Windows

SUB OBJECTIVE 16: The student will demonstrate ability to install a plate glass window using a zipper gasket.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses using a zipper gasket in storefront installation.

II. Instructor demonstrates using a zipper gasket to install a storefront.

A. Measure glazing frame.
B. Measure desired length of gasket.
C. Fit the gasket around the edge of the glazing channel.
D. Use vacuum cups to lift glass into vertical position.
E. Slip one of the vertical edges into the gasket.
F. Slip the other edge in.
G. Take a zipper tool and "zip" the glass in. Begin at the top left hand corner and zip down counterclockwise.

III. Students install plate glass windows using zipper tool.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to prepare and hang glass doors.

SOURCES OF INFORMATION

None

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Manufacturer's literature
- Student Resource Manual

FINISHING

CONTENT TITLE: Glass Doors

SUB OBJECTIVE I7: The student will demonstrate ability to prepare a sash for a glass door.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing a door frame for glazing.

   A. Clear away all burrs, projections and other obstacles to glazing.
   B. Clean grease off aluminum with a proper solvent.
   C. Paint a primer coat over steel.
   D. Let the primer coat dry.

II. Students prepare a door frame for glazing.

FINISHING

CONTENT TITLE: Glass Doors

SUB OBJECTIVE 18: The student will demonstrate ability to glaze a door.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installing glass doors.

II. Instructor demonstrates installing glass doors.

A. Install the outer gasket over the outer rim of the glazing channel.
B. Set two hard rubber, neoprene or nylon setting blocks 6" to 8" away from the upper outer corner of the glazing space, in the vertical and horizontal channels.
C. Set two neoprene or nylon setting blocks 6" to 8" away from the lower inner corner of the glazing space, in the horizontal and vertical channels.
D. Attach vacuum cups to the glass sheets.
E. Lift the glass into a vertical position.
F. Lift the glass into the glazing frame.
G. Slip the glass first into one vertical channel of the frame and then into the other.
H. Set the glass down so it rests in the bottom channel of the frame.
I. Remove the vacuum cups.
J. Insert the inner gasket seal in the glazing channel and flush with the line of sight.

III. Students install a glass door.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to install a variety of acrylic sheets.

SOURCES OF INFORMATION

Plexiglass in Architecture, (Rohm and Haas Company: Independence Mall West, Philadelphia, Pennsylvania 19105).

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Properties of acrylic materials

Communication Skills

- Student Resource Manual
- Manufacturer's literature
- Vocabulary development
- Related safety - using power equipment

FINISHING

CONTENT TITLE: Acrylics

SUB OBJECTIVE 19: The student will demonstrate ability to install a small acrylic sheet in a wooden sash.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses unique properties of acrylics.

II. Instructor demonstrates installing an acrylic sheet in a window pane.

A. Measure the rabbet.
B. Check manufacturer's recommendations for the desirable width and length of the pane in order to allow for heat expansion and contraction.
C. Form a bed in the rabbet with a non-hardening elastic glazing compound.
D. Center the pane in the bed.
E. Fasten the pane with glazing points.
F. Apply face sealant and trim it with a putty knife so it slopes away from the pane.

III. Students install an acrylic sheet in a window pane.

FINISHING

CONTENT TITLE: Acrylics

SUB OBJECTIVE 20: The student will demonstrate ability to install a large acrylic pane in a storefront sash.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses unique properties of acrylic sheets.

   A. They shrink and expand according to temperature more than glass or most other building materials.
   B. They bend under pressure more than glass.

II. Instructor demonstrates installing an acrylic storefront.

   A. Measure the rabbet.
   B. Check manufacturer's specifications for recommended length, width and thickness to allow for thermal expansion and contraction.
   C. Remove all obstacles in the rabbet--burrs, screw heads, bolts, etc.
   D. Prime paint wood and steel; clean aluminum with solvents.
   E. Set two neoprene setting blocks at quarters in the bottom glazing channel.
   F. Line the inner edge of the sash with butyl tape or 1/4" wide strip of silicone or polysulfide sealants.
   G. If you are using silicone or polysulfide sealants, below the strip of sealant, install a non-oily, continuous strip of filler tape.
   H. Apply masking tape to the acrylic sheet except where it fits in the rabbet.
   I. Clean the edges of the sheet with naphtha.
   J. Center the sheet in the sash.
   K. Attach the back of the sash or glazing channel.
   L. Remove excess glazing compound and masking tape.
   M. Wipe the sheet with a soft rag dipped in naphtha, kerosene or white (unleaded) gasoline.

III. Students install an acrylic sheet in a storefront sash.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to bevel and edge glass to several degrees of fineness by several techniques.

SOURCES OF INFORMATION

Berlye, Milton K., The Encyclopedia of Working with Glass, (Oceana Publications, Inc.: Dobbs Ferry, New York), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review math requirements for job entry or higher education and training

Science

- Cutting, grinding and polishing of glass

Communication Skills

- Related safety - using specialized power equipment
- Student Resource Manual
- Review communication skill requirements for job entry or higher education and training
- Review job and career opportunities
  - Apprenticeship
  - Job placement
  - Further education and training

FINISHING

CONTENT TITLE: Beveling and Edging

SUB OBJECTIVE 21: The student will demonstrate ability to edge glass to produce a ground finish.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses beveling and edging glass.

   A. The types of beveling and the degrees of edging.
   B. Safety considerations--wear goggles or a safety mask.

II. Instructor demonstrates using a portable sander to edge glass to a ground finish.

   A. Place the sheet of glass on a table with the edge to be ground overhanging by 1/4".
   B. Mount a number 60 (coarse) grit silicon-carbide belt on the sander.
   C. Turn on sander.
   D. Turn the belt to the glass edge.
   E. Move the sander back and forth so the entire belt surface is used.
   F. Lift the sander off the edge to avoid overheating it.
   G. Wash away chips and fragments after you have finished.

III. Students edge glass to a ground finish.

FINISHING

CONTENT TITLE: Beveling and Edging

SUB OBJECTIVE 22: The student will demonstrate ability to hand edge a piece of glass with a silicon-carbide stone.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses hand edging techniques.

II. Instructor demonstrates hand edging.

A. Set glass on table with edge overhanging slightly.
B. Take #49 sharpening stone and dip it in water into which kerosene has been mixed.
C. Rub the stone along the glass with a circular motion.
D. Dip stone in water frequently.
E. Repeat until glass edged.

III. Students will hand-edge glass with a silicon-carbide stone.

CONTENT TITLE: Beveling and Edging

SUB OBJECTIVE 23: The student will demonstrate ability to hand edge a piece of glass using silicon-carbide cloth.

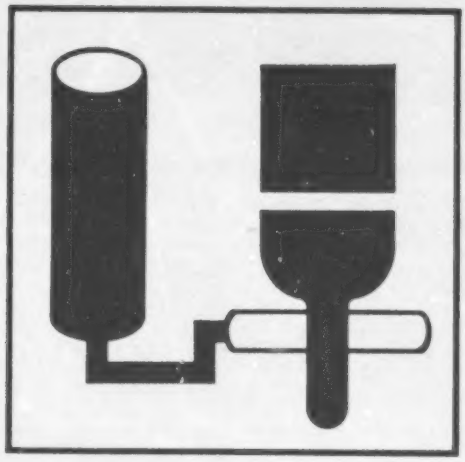
SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates using a silicon-carbide cloth to edge glass.

A. Tack silicon-carbide cloth to a small piece of wood.
B. Lay glass on table with edge overhanging 1/4".
D. Finish rub with a rough cloth.
E. Wash off dust and chips.

II. Students hand-edge glass with silicon-carbide cloth.

FLOOR COVERING



FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to prepare a floor for tile installation.

SOURCES OF INFORMATION

Installation Manual, (Armstrong Cork Co.: Lancaster, Pennsylvania), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals

Science

- Adhesives and floor contaminants

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Blueprint reading

FINISHING

CONTENT TITLE: Inspection

SUB OBJECTIVE 1: The student will demonstrate ability to inspect a job site.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates inspecting job sites.

A. Ensure that adequate electrical facilities are available.
B. Ensure that ventilation is adequate.
C. Ensure that adequate heat is available, or will be prior to installation of floors. A temperature of (at least) 70° F should be maintained from a period of 48 hours prior to beginning a job, to 48 hours after completion.
D. If installing on concrete slabs, ensure that concrete is even, dry, smooth and uncracked. Note: Often months are required for concrete to thoroughly cure. Students should be able to determine readiness of concrete.
E. On old concrete, remove all old varnish, paint adhesives and dirt.
F. Sweep thoroughly, and if possible, vacuum surface.
G. On wooden subfloors, nail down any loose boards, and remove any damaged ones, replacing as necessary.
H. Remove all previous finishes and sand down any uneven areas.

II. Students inspect a job site.

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 2: The student will demonstrate ability to test a concrete floor for moisture.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates testing a concrete floor for moisture.

A. Position relative humidity indicator on floor next to wall or pillar.
B. Cover indicator with square of polyethylene, 18" square or larger, and fasten to floor with friction tape.
C. If slab is 4" thick, or less, run test for 24 hours--if slab thickness exceeds 4", run test at least 72 hours.
D. Indicator temperature should be held as nearly constant as possible and should therefore be insulated with sheets of burlap, fiberglass or other insulator.
E. If indicator shows a relative humidity of 80 percent or more. slab is too damp--flooring should not be applied until later.

II. Students inspect a concrete slab for moisture.

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 3: The student will demonstrate ability to inspect and prepare a wooden floor, preparatory to installing resilient flooring.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparation of wooden floors for application of resilient flooring.

   A. Ensure that floor has at least 18" clearance underneath to prevent accumulation of moisture. Resilient flooring should not be laid over single wood floors, or over poorly ventilated floors.
   B. Remove any old paint, varnish, wax, dirt, etc. from old floor by sanding.
   C. Nail down loose boards. Remove and replace defective units.
   D. Fill and smooth cracks, holes or other surface irregularities which exceed 1/8". Use plastic wood for this.
   E. Plane or sand down any high spots.

II. Students prepare wooden floors for application of resilient flooring.

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 4: The student will demonstrate ability to prepare a concrete subfloor for application of resilient flooring.

I. Instructor demonstrates preparing a concrete subfloor for later application of resilient flooring.

A. If any paint, varnish, oil, etc. has not been removed, it should be removed before further preparations are undertaken.
B. Thoroughly clean out all cracks and expansion joint.
C. Dusty or chalky concrete should be swept clean and one coat of sizing applied.
D. Fill cracks, expansion joints, etc. with manufacturer's recommended latex filler or other floor patch compound. Compound is usually applied with a putty knife.
E. Smooth rough concrete with clean wet sand and a terrazzo grinder.
F. If floor cannot be smoothed, a coat of mastic should be applied.

II. Students prepare a concrete subfloor for application of resilient flooring.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to prime and apply sizing to subfloors.

SOURCES OF INFORMATION

Installation Manual, (Armstrong Cork Co.: Lancaster, Pennsylvania), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Material and tool sizing
- Computing square feet

Science

- Priming and sizing materials

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Related safety--working with volatile materials

FINISHING

CONTENT TITLE: Priming

SUB OBJECTIVE 5: The student will demonstrate ability to prime a subfloor preparatory to applying asphalt tile.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates priming subfloors preparatory to applying asphalt tile.

A. Ensure that subfloor is dry and free of hardening and curing agents.
B. Using smooth, even motions, apply a thin layer of primer to subfloor. Use a trowel, large squeegee or brush for this application.
C. Allow primer to set. If gray spots appear in the surface, apply more primer to these areas.
D. Allow primer coat to dry. Drying time under normal conditions is usually around 12 hours; primer is dry when it may be walked on.
E. Demonstrate cleaning application tools. Emphasize safety considerations. Ensure that adequate ventilation is provided both during application and cleaning operations.

II. Instructor demonstrates priming dusty, porous concrete floors and sanded-down wood floors.

A. Prepare sizing by mixing wax-free shellac and denatured alcohol in equal portions. Emphasize safety.
B. Demonstrate application of sizing using brushes or rollers. Ensure that adequate ventilation is provided.
C. Stress safety. Denatured alcohols, aside from being volatile in the extreme, are flammable and often poisonous. First aid for victims of internal ingestion, contact with eyes and/or mucous membranes, etc. should be outlined and practiced.

III. Students prime subfloors preparatory to applying asphalt tile.

FINISHING

CONTENT TITLE: Underlayments

SUB OBJECTIVE 6: The student will demonstrate ability to apply plywood underlayment materials.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing plywood underlayment materials.

A. Mention that plywood underlayments are applied to wood double floors with top layers of 3" tongue-and-groove boards and single wood floors with 3" or less tongue-and-groove boards.

B. Mention that material should be 1/4", solid-core interior plywood, A.P.A. underlayment grade.

C. Cover subfloor with roofing felt. This ensures a quiet finish floor.

D. Measure, cut and lay out sheets in ashlar style, long side parallel to sidewalls and subflooring.

E. Position sheets 1/64" apart. This space is conveniently measured by wedging a paper matchbook cover between sheets.

F. As units are spaced, fasten to subfloor with 3d ring-grooved or cement-coated nails. Nails should be closely spaced (usually 4" o.c.)

II. Students install plywood underlayment material.

FINISHING

CONTENT TITLE: Underlayments

SUB OBJECTIVE 7: The student will demonstrate ability to apply lining felts preparatory to application of plywood underlayments.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing a flat underlayment.

A. Lay out felt so that it runs across floor boards.
B. Using heavy shears or a knife, cut felt for a minimum of seams. Seams must be of the butt type. Any overlap will ultimately show through the final flooring.
C. Return, and make final, precision cuts before gluing. Turn all work upside down to remove curl.
D. Turn half of each piece over itself and sweep subflooring clean.
E. Spread a thin layer of adhesive on floor using a notched trowel. Demonstrate sizing quantity of material to spread at each time.
F. Fold felt over adhesive and roll down, spreading evenly over adhesive.
G. Fold opposite side back, and repeat process to completely glue felt into position. Repeat entire process for each piece of felt. Work must be neat. Do not re-use any spilled adhesive.
H. When laying paste pots over felt, position scraps of felt under pots to protect underlayment felt. When room has been felted, roll entire room, taking care not to scuff felt.

II. Students install felt underlayment.

FINISHING

CONTENT TITLE: Underlayments

SUB OBJECTIVE 8: The student will demonstrate ability to correct for minor unevenness between adjacent subfloors at doorways.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates beveling a doorway.

A. Cut a strip of lining felt approximately 6" wide and long enough to cover length of doorway.
B. Butt felt lengthwise against floor boards of higher floor.
C. Snap chalkline or otherwise measure a length 4" wide, parallel to doorway.
D. Spread paste in chalked-off area using notched trowel.
E. Spread felt strip across pasted strip; there should remain a 2" unpasted strip.
F. Allow paste to dry.
G. Firmly grasp unpasted strip of felt and pull upwards--the felt will split in a bevel.

II. Students bevel a doorway.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to install asphalt tile flooring.

SOURCES OF INFORMATION

Installation Manual, (Armstrong Cork Co.: Lancaster, Pennsylvania), 1969.

ACADEMIC RELATED SAFETY AND INFORMATION

Math

- Estimating computations
- Establishing centerlines

Science

- Properties of asphalt tile

Communication Skills

- Catalog work
- Working drawings
- Manufacturer's literature
- Student Resource Manual

FINISHING

CONTENT TITLE: Estimating

SUB OBJECTIVE 9: The student will demonstrate ability to estimate the amount of tile required to cover a specified room area.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating tile.

A. Demonstrate use of tile estimation tables.
B. Demonstrate determining tile requirements by hand. Start by determining the square footage of the area.
C. Multiply area (in square feet) by 1.7778. This will give the number of tile required, if tile is standard 9 x 9 tile. For 9 x 18, 1/2 as many will be needed as for 9 x 9 tile; alternately, multiply area (in square feet) by .889.
D. For 12 x 12" tile, the number of tile required equals the number of square feet; for 6 x 6 tile, the number required is four times that for 12 x 12 tile.
E. Allow for waste. Standard waste figures are as follows:
0 to 50 square feet, allow 14 percent for waste.
50 to 100 square feet, allow 10 percent for waste.
100 to 200 square feet, allow 8 percent for waste.
200 to 300 square feet, allow 7 percent for waste.
300 to 1000 square feet, allow 5 percent for waste.
Over 1000 square feet, allow 3 percent for waste.

II. Students estimate tile.

FINISHING

CONTENT TITLE: Laying Out Tile

SUB OBJECTIVE I0: The student will demonstrate ability to lay out tile preparatory to installation in a room.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out tile.

A. Measure perimeter of floor surface with tape measure.
B. Square-off room.
C. Snap chalklines around squared-off area.
D. Measure off half length and width of squared-off area.
E. Snap chalklines from half points of one width to half points of other width. Repeat for half points of room length.
F. Beginning at center, lay out rows of tile along center lines, moving in each direction.
G. If less than one full tile is required to complete rows in either direction, adjust centers so that end pieces of equal width may be laid.
H. Mark new room "center" if changed.

II Students lay out tile.

FINISHING

CONTENT TITLE: Application

SUB OBJECTIVE II: The student will demonstrate ability to apply asphalt tiles in plain and checkered designs.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates spreading adhesive.

A. Spread adhesive over half of room area, leaving open spaces to allow for placement of tools, and to permit viewing of chalklines.
B. Strike new chalklines over old.
C. Fill in any voids.
D. When tile has been laid in one half of room, repeat for other side.

II. Instructor demonstrates laying tile.

A. Position first tile squarely in place, centered on intersection of chalklines.
B. Position following tiles next to previously laid ones. Positioning should be accurate, and tile should not be squeezed in either direction as this forces adhesive up between tiles.
C. Lay tiles out in two courses, intersecting at center of room to form a +. Trim tiles as required to fit against walls.
D. Demonstrate laying two colors of tiles. This is usually done in a back and forth diagonal motion, each succeeding tile laid such that its corner touches the corner of the one previously laid.
E. Remove excess adhesive with a putty knife and dampened steel wool. Put no heavy weights on floor while adhesive sets. Do not wash for at least 5 days.

III. Students install asphalt tile.

FINISHING

CONTENT TITLE: Tile Application

SUB OBJECTIVE I2: The student will demonstrate ability to apply tiles to a diagonal.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and setting tiles to a diagonal.

   A. Square room and snap chalklines as for standard installation.
   B. From center point 0, take any convenient radius and snap points W, X, Y and Z on center lines.
   C. Strike diagonals at a 45° angle to center lines. To do this, take any radius greater than OX or OY and make intersecting arcs at point A. Using the same radius and points YZ, ZW and WX, strike points D, B and C as before. Strike diagonal chalklines AB and CD.
   D. Using lines AB and CD as center lines for room, lay out tile, adjust center point and install tile as in any regular installation.

II. Students lay out and set tile to a diagonal.

FINISHING

CONTENT TITLE: Tile Cutting

SUB OBJECTIVE 13: The student will demonstrate ability to make straight and diagonal cuts on tiles.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out straight and diagonal cuts on tiles.

   A. Run course up to point where less than one full tile will be required to reach wall.
   B. Heat tile if desired, and turn tile upside down. DO NOT rotate tile when doing so unless it is desired to break pattern.
   C. Lay tile on floor and butt against wall.
   D. Using last-laid tile as a cutting guide, cut upside down tile. Discard piece lying nearest wall.
   E. Remaining half will now, when inverted, be cut to size required for the fit.
   F. Diagonals are cut similarly except:
      1) When tile has been inverted, rotate so that one edge abutts wall.
      2) Slide tile down so that adjacent edge touches nearest corner (to wall) of last-laid tile.
      3) Cut and discard as before.

II. Students lay out straight and diagonal cuts on tiles.

FINISHING

CONTENT TITLE: Tile Cutting

SUB OBJECTIVE 14: The student will demonstrate ability to fit tile around pipes and other circular obstacles.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fitting tile around circular and irregularly shaped objects.

   A. Lay tile over last-laid tile and mark off two parallel lines (separation equal to diameter of pipe) using a carpenter's square.
   B. Measure and locate center of obstacle, and scribe a circle there using dividers. Circle should be tangent to both lines previously scribed.
   C. Cut out inscribed circle if object may be lifted before positioning tile. If object may not be lifted, cut a notch, following parallel lines first scribed. Cut off end of remaining "key" following scribed circle.
   D. Check fit of tile. When fit is accurate, spread adhesive, and slip tile into position. If using a notched tile, fit "key" into position behind obstacle.
   E. For irregular shapes, set a pair of scribers to distance separating last-laid tile and wall or object.
   F. Scribe along object, scribing on face of tile. Cut tile to fit.

II. Students fit tile around circular and irregular shaped objects.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to install sheet flooring materials in a room.

SOURCES OF INFORMATION

Installation Manual, (Armstrong Cork Co.: Lancaster, Pennsylvania), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Properties of various sheet flooring materials
- Uses of special seaming materials

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Vocabulary development

FINISHING

CONTENT TITLE: Endwall Fitting

SUB OBJECTIVE 15: The student will demonstrate ability to run first strip of sheet vinyl and fit it to endwalls.

SUGGESTED ACTIVITIES: (Students and Teachers)

1. Instructor demonstrates running first strip of vinyl and fitting it to endwalls.

   A. Measure room from end to end in the direction desired to lay floor. (Seams should be minimized.)
   B. Roll out first strip of vinyl, face inward to uncurl material.
   C. Measure vinyl, adding about 3" to total length and cut.
   D. Position vinyl and butt against endwall. Set a pair of scribers (or dividers) to maximum distance between wall and vinyl, and scribe off this distance on material. Cut along scribed line.
   E. Spread adhesive and butt material against endwall. Leave a space about 3' wide at opposite end of room free of adhesive.
   F. Position vinyl and press into place. Lap free end up against remaining endwall.
   G. Set dividers or scribers to a wide space (9 to 12" or so). Mark this distance on floor adjacent to selvage edge of vinyl material.
   H. Also mark this distance on selvage edge of material itself. Mark need not cover entire width of material; in fact, a tick mark will do.
   I. Pull flooring back and buckle so that end may be abutted to endwall.

Continued...

FINISHING

CONTENT TITLE: Endwall Fitting (Continued)

SUB OBJECTIVE I5: The student will demonstrate ability to run first strip of sheet vinyl and fit it to endwalls.

SUGGESTED ACTIVITIES: (Students and Teachers)

J. Measure distance between mark on floor and mark on selvage edge of vinyl. Set dividers or scriber to this distance.

K. Trace this distance along end of material by running scriber parallel to endwall. This is the cut line.

L. Cut material and check fit. Spread adhesive and glue into position.

II. Students run first strip of vinyl and fit it to endwalls.

FINISHING

CONTENT TITLE: Seams

SUB OBJECTIVE 16: The student will demonstrate ability to make a tight fitting seam between strips of vinyl.

SUGGESTED ACTIVITIES: (Students and Teachers)

1. Instructor demonstrates various methods of making seams in vinyl.

   A. Demonstrate double-cut method of making a seam.
      1) Apply adhesive to first strip so as to allow material to be folded back along the long axis.
      2) Lay out and fit second strip, with opposite side of material bonded to subfloor. Allow for desired overlap.
      3) Lay straightedge along desired point of fit. It should be midway between either selvage edge. Cut both strips simultaneously. Remove selvage strips.
      4) Apply adhesive and abutt strips together. Note: It may be desirable to demonstrate use of special double cut machines now available for performing this operation. Follow manufacturer's recommendations for adhesive application, etc. Roll seam down.

   B. Demonstrate underscribing method of making seams in vinyl.
      1) Lay out first strip as for double cut method.
      2) Adjust scriber to mark exactly over previously cut edge below.
      3) Scribe cut line, and cut along line. Discard selvage strip.
      4) Apply adhesive and abutt strips together. Roll seam down.

Continued...

FINISHING

CONTENT TITLE: Seams (Continued)

SUB OBJECTIVE 16: The student will demonstrate ability to make a tight fitting seam between strips of vinyl.

SUGGESTED ACTIVITIES: (Students and Teachers)

C. Demonstrate single-cut method of making a seam in vinyl.
   1) Trim and lay out first strip as for underscribed method.
   2) Slip abutting strip beneath first strip.
   3) Using pre-trimmed edge of first strip as a guide, cut second strip. Lift first and remove selvage strip.
   4) Apply adhesive and abutt strips. Roll seam down.

II. Students prepare tight fitting seams between strips of vinyl.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to plan, lay out and install carpeting.

SOURCES OF INFORMATION

Duffin, D. J., The Essentials of Modern Carpet Installation, (Van Nostrand Reinhold Co., Division of Litton Educational Publications, Inc.: 450 West 33rd Street, New York, New York), 1962.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Using special formula for area computations
- Review of math requirements for job entry and/or higher education

Science

- Properties of various carpeting materials, styles and types

Communication Skills

- Manufacturer's literature and technical literature
- Catalog and samples
- Vocabulary development
- Review of communication skill requirements for job entry and/or higher education
- Review job and career opportunities in floor covering industry
  - Job
  - Apprenticeship
  - Higher education

FINISHING

CONTENT TITLE: Room Measurement

SUB OBJECTIVE 17: The student will demonstrate ability to measure a regular room by the overall and "broken" methods of measurement.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates measuring a regular room.

A. Measure room by taking all broken measurements; i.e., measure distances between doorways, across doorways, between and across obstructions, etc., and add measurements together.

B. Check broken measurements by making overall measurements from endwall to endwall.

C. Compare broken and overall measurements for conformity. Remeasure where necessary to bring figures into conformity.

D. Follow same procedure throughout structure or area to be carpeted.

E. For purpose of demonstration, and often in the field, it is desirable to draw a freehand sketch, as near to scale as possible. The sketch will prove invaluable in later units when students are grappling with the problems of reducing waste by means of provident layout of the work.

II. Students measure a rectangular room.

FINISHING

CONTENT TITLE: Estimating

SUB OBJECTIVE 18: The student will demonstrate ability to estimate the quantity of carpet which will be required to cover a given irregular area. The student will have to consider waste, pattern matching, seams and traffic requirements, etc.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses estimating carpet requirements.

A. Point out difference between real and theoretical yardage requirements.

B. Discuss determining theoretical yardage requirements. Demonstrate dividing room into their component rectangles, triangles and circles. Give appropriate formulae for determining areas of each of these components; i.e.,

area of a rectangle	=	length x height
area of triangle	=	1/2 x base x height
area of circle	=	πr^2, where $\pi = 3.1416$ and r^2 = radius of circle (multiplied by itself)
one square yard	=	9 square feet

C. Discuss determining actual yardage requirements. Emphasize that in final layout, patterns must match, all carpet must lay in same direction and offset seams in high traffic areas (preferably all seams in high traffic areas) must be avoided.

D. Have students experiment, on paper, with carpet installations of varying types. They should calculate waste for carpet installed with seams running one direction, and with seams running the opposite direction. In addition, they must determine advantageous starting points to obtain balanced and optimum matching of patterns consistent with low waste. Once layout has been determined, actual waste may be calculated.

II. Students estimate carpet requirements for an irregular area.

FINISHING

CONTENT TITLE: Pattern Matching

SUB OBJECTIVE 19: The student will demonstrate ability to match pattern on set match, drop match and quarter drop match carpet designs.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses design types.

A. Describe set match design; set match designs have half the design complemented on the opposite edge. Design is completed when another strip is laid.

B. Describe drop match design types: Drop match designs have complementary designs matched on the next strip, diagonally opposite first.

C. Describe quarter drop match designs; quarter drop match designs have four blocks in each figure repeat of the figure.

II. Instructor demonstrates matching various carpet designs.

A. Demonstrate matching set match designs. Use multiples of the repeat to do this.

B. Demonstrate matching drop match designs. Use multiples of the repeat or multiples plus half the repeat to do this.

C. Demonstrate matching quarter drop match designs. Use multiples of the repeat, or multiples of the repeat plus any number of quarters of the repeat.

III. Students match various carpet designs.

FINISHING

CONTENT TITLE: Padding

SUB OBJECTIVE 20: The student will demonstrate ability to lay out, cut to fit and install padding preparatory to laying carpet.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and installing padding.

A. Measure room and plan layout. Do not allow seams in padding to match seams in carpet. Otherwise, no special considerations are necessary.
B. Roll out padding in a large, flat area if possible. (Often, the largest room is used for layout, and installed last.)
C. Measure laid-out padding carefully using a steel tape measure.
D. Make 1/2" cuts in edges of padding with shears wherever cuts are required.
E. Snap chalk lines between cuts to determine line of cut. Do not trust cutting along pattern lines, etc., as they may be deceptive.
F. Cut padding along chalklines using heavy carpet shears.
G. Lay out padding in room for installation. Abutt pieces against one another.
H. Tack or staple abutting ends in place, or on concrete fasten to floor with a recommended adhesive. Ends may also be sewn or taped.
I. Tack outside edges, spacing tacks closely (usually 6" apart) or staple.
J. Trim outside edges to allow for installation of tackless stripping, as necessary.

II. Students lay out and install carpet padding.

FINISHING

CONTENT TITLE: Floor Preparation/Tackless Strips

SUB OBJECTIVE 21: The student will demonstrate ability to clean and prepare a floor surface for installation of carpet.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing a floor for installation of carpet.

A. Clean wooden floors and remove splinters, protruding nail heads, etc. Floors need not be as smooth as for resilient floor installation, but should nonetheless be relatively clean and smooth.

B. Repair cracks, excessively wide seams, etc. Fill holes in wood or concrete using recommended fillers and/or patches.

C. Mention that this step is usually performed prior to installation of padding, and either before or after removal of base molding materials.

II. Instructor demonstrates installing tackless strips.

A. Remove molding. To do this, cut paint lines between base molding strips. Then remove base molding with a "base shoe remover." Finally, remove old nails or tacks from base molding and use new ones when replacing material. Strips may be marked for later identification to ensure proper reinstallation.

B. Install padding if this has not already been done.

C. Measure, cut and lay out tackless strip. Cut strips with priming shears, hacksaws or other fine-toothed saws. Take care not to run saw blades into pins.

D. Position strips along walls, pins directed inwards.

Continued...

FINISHING

CONTENT TITLE: Floor Preparation/Tackless Strips (Continued)

SUB OBJECTIVE 21: The student will demonstrate ability to clean and prepare a floor surface for installation of carpet.

SUGGESTED ACTIVITIES: (Students and Teachers)

E. Nail strips into position (wood floor applications), allowing a space between strip and wall. (Usual spacing is approximately 1/2" between top of pins and base of wall.)

F. Strips may be glued onto concrete floors with linoleum, adhesive; alternately, powder-actuated stud drivers may be used to nail strips to concrete. In any case, fasteners should be fairly closely spaced (usually 6 to 9"). Also, adhesives must be given adequate time to set prior to application of carpet.

III. Students prepare floors and install tackless strips.

FINISHING

CONTENT TITLE: Carpet Seams

SUB OBJECTIVE 22: The student will demonstrate ability to bind a carpet by face taping seams.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates binding a carpet by face taping the seams.

A. Roll out and stay tack carpet into position as done in back taping seams. However, second strip should overlap first slightly.
B. Unroll tape and center along proposed seam line. It may be desirable to mark seam position with a pencil and a taut line.
C. Apply sealant to tape and allow to set. Follow manufacturer's recommendations for drying time, etc.
D. Fit seams together smoothly, forcing carpet strips together. Fit should be tight so as to reduce visibility of seam.
E. Lay sandbags along seam and allow seam to dry.
F. Roll seam flat.

II. Students bind carpets by face taping the seams.

FINISHING

CONTENT TITLE: Seams

SUB OBJECTIVE 23: The student will demonstrate ability to bind a carpet by taping the back seams.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates taping the back seam of carpet.

A. Stay tack carpet into position at one end using 3 or 4 tacks placed 2 or 3" from edge.
B. Stretch carpet with knee kicker and stay tack into position entire length of carpet. Rows of stay tacks should be about 6 to 8" apart.
C. Butt second strip against first and stay tack into position as for first strip.
D. Fold open carpet entire length of seam.
E. Spread adhesive along 3 foot strips of floor. Take care not to spatter carpet with adhesive. Set adhesive can on old carpet or paper; always twirl brush gently to remove excess, etc.
F. Run tape along seam line and apply another coat of adhesive. Continue operation along entire length of seam.
G. Allow adhesive to set--follow manufacturer's recommendations for drying time.
H. Fold carpet down neatly to make seam. Roll seam down firmly with roller.
I. Remove stay tacks.

II. Students bind a carpet by taping the back seams.

FINISHING

CONTENT TITLE: Carpet Seams

SUB OBJECTIVE 24: The student will demonstrate ability to fasten carpet by stitching it together. The student should demonstrate proficiency in a variety of stitches and should be able to work from bottom and top as well as top alone.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates carpet stitches.

   A. Demonstrate straightforward stitches, bottom and top.
   B. Demonstrate sewing carpet from the top.
   C. Demonstrate sewing crowfoot stitch.
   D. Demonstrate cross stitching and overcast stitching.

II. Students bind carpet by hand.

FINISHING

CONTENT TITLE: Carpet Installation

SUB OBJECTIVE 25: The student will demonstrate ability to lay out and fasten carpet.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing carpet.

A. Prepare floor and install tackless strips if this has not been done. Cut carpet to size and sew or glue strips together. Roll up and move into work area.

B. Unroll carpet and position in room. Lap edge up wall by about 3/8" using a small awl.

C. Press carpet flush with wall using fingers. Repeat ironing carpet to wall with carpet hammer. Ensure that carpet is hooked for about a foot along each wall at the starting corner.

D. Using the knee kicker, alternately stretch and hook carpet to strip all along first wall (usually the long one). Or, use power stretcher with extensions as necessary and stretch carpet and hook to opposite corner on same wall. Iron against strip and wall.

E. Starting again at starting corner, iron carpet against short wall. Stretch as before and hook all along tackless strip. Iron carpet along strip and against wall.

F. Using power stretcher, stretch and hook carpet along length of room opposite first applied wall. Stretch will also have to be applied toward final corner. Carpet may be alternately stretched and hooked in both directions until it lays flat.

G. When hooking is complete, iron into position.

H. Force carpet into gully between tackless strip and wall using a small awl, putty knife, etc.

II. Students install carpet.

FINISHING

CONTENT TITLE: Fitting Carpet

SUB OBJECTIVE 26: The student will demonstrate ability to fit carpet around pipes, under radiators, etc.

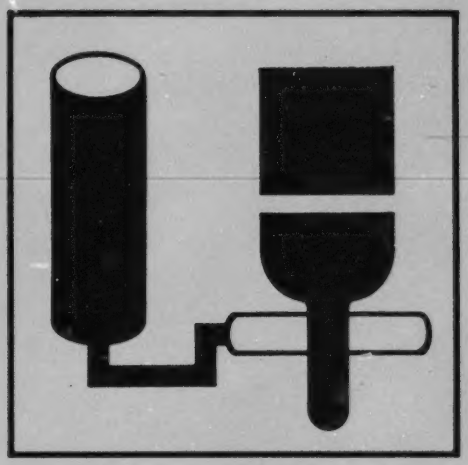
SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fitting carpet around pipe.

A. Spread latex on carpet backing to prevent ravelling.
B. Turn back carpet and measure distance from nearest edge to pipe's center.
C. Cut along marked-off line with a carpet knife or shears to distance from edge to pipe's center.
D. Cut flaps around fitting for pipe.
E. Fold flaps under carpet and lay carpet into position. If carpet must be cut to slip around pipe (as in under radiators) yet seam must stand any wear or visible exposure, face or back glue seam to floor.

II. Students fit carpet around pipes, under radiators, etc.

LANDSCAPING



FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to identify plants by their scientific names and growth habits.

SOURCES OF INFORMATION

Taylor, Norman, Encyclopedia of Gardening, (Houghton Mifflin Co.: 2 Park Street, Boston, Massachusetts 02107), 1961.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Unit Costs
- Measuring
  - Whole numbers
  - Fractions
  - Decimals

Science

- Botany introduction
- Environmental needs

Communication Skills

- General plant information literature
- Why landscape?
- Landscaping limitations
- The need to know plant classifications
- Making a landscaping plan
- Basic vocabulary development

FINISHING

CONTENT TITLE: Plant Identification

SUB OBJECTIVE 1: The student will demonstrate ability to identify plants by their scientific names and growth habits.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor emphasizes the importance of gaining as much knowledge as possible pertaining to plants used in landscaping project.

A. Discuss plant kingdom.
B. Discuss the use of scientific plant classification. Mention divisions by common name, genus, species and variety.
C. Point out descriptive terminology needed in identification. Mention and define such terms as: Tree, shrub, flowers, bulbs, grasses, vines, ground covers, foilage plants, house plants, borders, bedding plants, specimen.
D. Identify common plants for students.
E. Stress need for correct utilization of various plants in a landscape.
F. Point out to student the various plant characteristics or growth habits or environmental requirements which would aid in identification and correct utilization of plants.
G. Discuss physical characteristics such as geometric form, size, height, color, texture of leaves, limbs, trunk, color, shape and fragrance of flowers, shape, size and edibility of fruit.
H. Discuss environmental requirements such as hardiness, temperature, growing media, light, water, range, nutrient.

II. Student identifies several common plants, giving correct name and characteristics for each.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to draft a simple landscape plan.

SOURCES OF INFORMATION

Better Homes and Gardens Garden Book, (Meredith Publishing Co.: 1716 Locust Street, Des Moines, Iowa 50336), 1969.

Better Homes and Gardens Landscape Planning, (Meredith Publishing Co.: 1716 Locust Street, Des Moines, Iowa 50336).

Bush-Brown, James and Louise, America's Garden Book, (Charles Scribner's Sons: 597 5th Avenue, New York, New York 10017), 1966.

Snyder, Rachel, The Complete Book for Gardeners, (D. Van Nostrand Reinhold Co.: 450 West 33rd Street, New York, New York 10001), 1964.

Taylor, Norman, Encyclopedia of Gardening, (Houghton Mifflin Co.: 2 Park Street, Boston, Massachusetts 02107), 1961.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Elevation measurements
- Scale measurements
- Chart and table interpolation

Science

- Botany (continued)
- Elements necessary for plant growth
  - Water
  - Sunlight
  - Nutrients
  - Organisms

Communication Skills

- Technical literature - need for planning
- Blueprint interpretation
- Use of symbols
- Project programming

FINISHING

CONTENT TITLE: Landscape Drafting

SUB OBJECTIVE 2: The student will demonstrate ability to draft a simple landscape plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses landscape design.

A. Demonstrate simple elements of design.
B. Identify use of property--recreation, private, etc.; selection and location of plants (growth characteristics--size, color, form, texture, susceptibility to disease and insects); selection and location of landscaping structures (benches, bird baths, picnic tables, stepping stones, flower beds, planter boxes, sundials, etc., as well as walks, drives and patios).
C. Define design terminology. Discuss balance, harmony, simplicity, sequence, scale, composition, privacy, beauty, pleasure, convenience, symmetry, unity.

II. Instructor demonstrates constructing a sample landscape drawing.

A. Explain purpose of a landscape drawing.
B. Demonstrate tools necessary to construct drawing.
C. Draw sample plan on the board.
D. Demonstrate drawing to scale.
E. Demonstrate use of symbols.
F. Discuss use of legends.
G. Stress neatness, accuracy.

III. Student draws a simple landscape plan.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to test soils, identify undesirable organisms present in soil samples, and select and prepare fertilizers and additives to be used in the preparation of a landscape.

SOURCES OF INFORMATION

Better Homes and Gardens Garden Book, (Meredith Publishing Co.: 1716 Locust Street, Des Moines, Iowa 50336), 1969.

Bush-Brown, James and Louise, America's Garden Book, (Charles Scribner's Sons: 597 5th Avenue, New York, New York 10017), 1966.

Snyder, Rachel, The Complete Book for Gardeners, (D. Van Nostrand Reinhold Co.: 450 West 33rd Street, New York, New York 10001), 1964.

Taylor, Norman, Encyclopedia of Gardening, (Houghton Mifflin Co.: 2 Park Avenue, Boston, Massachusetts 02107), 1961.

Continued...

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to test soils, identify undesirable organisms present in soil samples, and select and prepare fertilizers and additives to be used in the preparation of a landscape. (Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Degrees and angles
- Elevation measurements
- Charts and table interpolation

Science

- Soil elements and organisms
- Soil testing of samples
- Soil treatment
  - Additives
  - Sterilization
  - Neutralizers
  - pH

Communication Skills

- Technical surveying techniques
- Student Resource Manual
- Technical testing literature
- Preparing reports

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 3: The student will demonstrate ability to prepare a site for landscaping.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates surveying and preparing a site for landscaping.

   A. Introduce and demonstrate specific tools necessary for site preparation such as hand tools, power tools and transit.

   B. Demonstrate techniques for site preparation such as clearing and the use of tractors and other power tools, leveling and using a transit, providing for drainage and the addition of soil and soil additives.

II. Students prepare a job site for landscaping.

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 4: The student will demonstrate ability to determine the nature and origin of soils by examination, and to test them for their basic nutrients using a simple soil test kit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces the subject of soils and demonstrates soil testing.

   A. Discuss origin of soils.
   B. Discuss types of soils.
   C. Discuss nature of soil particles.
   D. Discuss characteristics of good soil.
   E. Discuss the elements of soil nutrition. Include discussion of major and minor nutrients and soil pH.

II. Instructor demonstrates making soil tests.

   A. Demonstrate making soil test for nitrogen.
   B. Demonstrate making soil test for phosphorous.
   C. Demonstrate making soil test for potash content.
   D. Demonstrate testing soil pH.
   E. Mention that accurate soil tests are usually performed at the nearest agricultural university.
   F. Discuss soil sterilization and demonstrate sterilizing soils by the steam and chemical methods.

III. Students anaylze, test, discuss and sterilize soil samples.

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 5: The student will demonstrate ability to identify harmful and beneficial organisms in soils and to evaluate the need for and to select appropriate soil additives.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses soil organisms.

   A. Identify and discuss life cycles of beneficial soil organisms.
   B. Identify and discuss life cycles of destructive or generally harmful soil organisms.

II. Instructor demonstrates the use of various soil additives used to improve soil conditions.

   A. Demonstrate using natural materials such as peatmoss and bark.
   B. Demonstrate using man-made materials such as perlite and vermiculite.
   C. Demonstrate using lime.
   D. Demonstrate the use of mulches, both organic and inorganic varieties.
   E. Demonstrate adding and mixing sand.

III. Students identify soil organisms and select soil additives appropriate for soils previously tested and for plants previously selected.

FINISHING

CONTENT TITLE: Preparation

SUB OBJECTIVE 6: The student will demonstrate ability to determine and apply the correct fertilizer required for a specific soil type.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates using fertilizer.

   A. Discuss types of fertilizers. Mention liquid, granular and organic types.
   B. Demonstrate calculating the percentages of each element in the container.
   C. Demonstrate calculating the amounts of each element to apply to comply with the results of the soil tests.
   D. Demonstrate proper methods of application.
   E. Demonstrate how elements in fertilizer affect plant growth.
   F. Demonstrate proper watering techniques to be used after fertilizing.

II. Students select a proper fertilizer for an analyzed soil and apply.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to plant trees, shrubs and other popular garden plants, install lawns by a variety of methods, design and install underground watering and lighting systems, and construct garden accessories out of various materials to execute a landscape plan.

SOURCES OF INFORMATION

Better Homes and Gardens Garden Book, (Meredith Publishing Co.: 1716 Locust Street, Des Moines, Iowa 50336), 1969.

Better Homes and Gardens Landscape Planning, (Meredith Publishing Co.: 1716 Locust Street, Des Moines, Iowa 50336).

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Bush-Brown, James and Louise, America's Garden Book, (Charles Scribner's Sons: 597 5th Avenue, New York, New York 10017), 1966.

Snyder, Rachel, The Complete Book for Gardeners, (D. Van Nostrand Reinhold Co.: 450 West 33rd Street, New York, New York 10001), 1964.

Taylor, Norman, Encyclopedia of Gardening, (Houghton Mifflin Co.: 2 Park Avenue, Boston, Massachusetts 02107), 1961.

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Continued...

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to plant trees, shrubs and other popular garden plants, install lawns by a variety of methods, design and install underground watering and lighting systems, and construct garden accessories out of various materials to execute a landscape plan. (Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math
- Square feet
- Layout measurements
- PSI
- Material estimation

Science
- Botany - root systems and soil preparation
- Electrical and water systems

Communication Skills
- Nursery instructions
- Technical literature
- Manufacturer's literature
- City codes on electrical and water systems

FINISHING

CONTENT TITLE: Executing Landscapes

SUB OBJECTIVE 7: The student will demonstrate ability to plant trees, shrubs and other popular garden plants.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates proper planting methods for trees, shrubs, etc.

   A. Select proper tools.
   B. Dig hole wider and deeper than root system of plant.
   C. Place a small amount of a good soft soil mixture in bottom of hole.
   D. Properly place plant in hole facing best side of plant to the public.
   E. Add a good soil mixture until hole is approximately 1/2 full.
   F. Water thoroughly to allow air pockets to escape.
   G. Allow time for soil to settle. Then add soil mixture to the hole until the old soil level of plant is reached.
   H. Water thoroughly.
   I. Stake plant on three sides if deemed necessary.

II. Student plants trees, shrubs, etc.

FINISHING

CONTENT TITLE: Executing a Landscape

SUB OBJECTIVE 8: The student will demonstrate ability to plant a new lawn from seed.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates planting a new lawn from seed.

- A. Identify lawn grasses.
- B. Discuss culture of various grasses; hardiness, shade, sun, soil, water, fertilizer, mowing requirements.
- C. Select proper tools for preparation of seed bed.
- D. Fertilize seed bed.
- E. Mix in soil additives as required.
- F. Cultivate several inches deep.
- G. Rake and level.
- H. Calculate area to be covered for seeding.
- I. Calculate seeding rate.
- J. Demonstrate methods of seed application.
- K. Pack or roll seed bed.
- L. Water thoroughly.
- M. Cover area with soft cl[illegible] if deemed necessary.

II. Students install a new lawn from seed.

FINISHING

CONTENT TITLE: Executing a Landscape

SUB OBJECTIVE 9: The student will demonstrate ability to install a new lawn by sprigging, plugging or sodding.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing a lawn by sprigging, plugging or sodding.

A. Calculate area to be covered.
B. Calculate amount of grass needed.
C. Dig small holes for plugs.
D. Insert plugs in hole.
E. Partially cover plugs with soil.
F. Roll or tamp plugs lightly.
G. Dig small trenches for sprigs.
H. Lay sprigs into trenches.
I. Cover sprigs partially with soil.
J. Tamp or roll sprigs lightly.
K. Place sod on seed bed.
L. Cover sod partially with soil.
M. Roll or tamp sprigs lightly.
N. Water all grass thoroughly.

II. Student installs a new lawn by sprigging, plugging or sodding.

FINISHING

CONTENT TITLE: Executing a Landscape

SUB OBJECTIVE 10: The student will demonstrate ability to construct a simple underground watering system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates constructing a simple underground watering system.

A. Calculate area to be covered.
B. Locate all obstructions, such as buildings, walks, etc.
C. Draw plan on paper to scale to make sure of proper sprinkler coverage in all areas of the ground.
D. Calculate water pressure in pounds per square inch using a pressure gauge, making sure all other outlets are closed.
E. Determine number of sprinklers that will operate at the known (psi), keeping in mind the size of water pipe used, the distance water has to travel, and the number of areas that would increase friction.
F. Demonstrate procedure for calculating materials needed.
G. Using previously drawn plan, lay out pipe and fittings on top of ground.
H. Connect system on top of ground.
I. Flush line and then connect sprinkler heads.
J. Check for leaks.
K. Dig a trench 6-8" deep and install system in ground.
L. Level all sprinklers to the desired height and adjust spray.
M. Fill trench.

II. Students construct a simple underground watering system.

FINISHING

CONTENT TITLE: Executing a Landscape

SUB OBJECTIVE 11: The student will demonstrate ability to design and construct a simple lighting system for a garden.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces garden lighting.

A. Discuss various types of lighting such as safety lighting for walks, entrances, etc., illumination for garden plants or special landscaped areas, and general lighting for patios and recreational areas.

B. Discuss light sources and their characteristics; include a comparison of fluorescent and incandescent types, 110 volt and low voltage DC types, floodlights and indirect lighting and discussion of the various colors obtained in various light sources and in deflectors.

II. Instructor demonstrates designing a lighting plan.

A. Decide on type of wiring, whether underground weather-proof or conventional.

B. Calculate type of lighting needed for a particular area.

C. Figure the type and placement of sources.

D. Decide whether to use weather-proof outdoor plugs or conventional ones.

E. Discuss types of fixtures necessary to most adequately light the desired area.

F. Emphasize to students the necessity of discerning what the electrical code is for a particular area and the importance of following it.

G. Emphasize safety during and after installation. Include safety considerations unique for various types of weather.

H. Point out the possible hazards of lighting such as attraction of undesirable insects, abnormal growth of some plants or the possibility of destroying the blooming time in some photosensitive plants.

III. Students construct a simple lighting system for a garden.

FINISHING

CONTENT TITLE: Executing Landscapes

SUB OBJECTIVE 12: The student will demonstrate ability to construct accessories for a garden.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces construction in the executing of a landscape.

A. Introduce the names and uses of the tools common to the various areas of landscape construction such as hammers, saws, squares, drills, bits, levels, trowels, wrenches, pliers, rules, shovels, hoes, rakes, planes, power tools, paint brushes, wheel barrows, transits and files.

B. Demonstrate basic construction techniques common to many types of landscape construction. Include:

1. Measuring - use of rule, tape, etc.
2. Using a square.
3. Selecting correct saw and proper sawing techniques on various materials.
4. Drilling holes in various materials such as wood, mortar, metal or concrete.
5. Selecting proper nails, hammers and hammering techniques.
6. Using levels and transits.
7. Constructing forms for making various landscape objects from concrete.
8. Selecting proper ingredients and ratios to mix with concrete for use as mortar or cement in patios, stepping stones, benches, etc.
9. Proper techniques for mixing and placing concrete.
10. Correct procedure for finishing concrete.
11. Techniques for mixing mortar.
12. Use of trowel in handling mortar.
13. Simple steps in using trowel and in laying bricks, cement blocks, rocks, etc.
14. Installing expansion joints in concrete.
15. Using reinforcing steel in concrete.

II. Students build landscape construction items as directed.

FINISHING

CONTENT TITLE: Executing Landscapes

SUB OBJECTIVE 13: The student will demonstrate ability to construct wooden forms for concrete.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the techniques of constructing a simple wooden form for containing cement to make a concrete object to be used in the execution of a landscape plan, such as stepping stones, benches, flower bed borders, etc.

   A. Identify components of form; 3/4" plywood, 2 x 4's, 2 x 2's, 1 x 4's, nails, bolts, hinges.
   B. Identify tools necessary for construction of forms: Hammer, saw, drill, bits, rule, square, level, oil can, etc.
   C. Square and cut lumber to the desired length and shape.
   D. Demonstrate placing each component to ensure proper fit.
   E. Nail or bolt components together.
   F. Demonstrate method of disassembling components for removal of concrete object.
   G. Explain oiling or applying form release compound to prevent concrete from adhering to form.
   H. Explain that proper maintenance of forms will ensure extended use over the years.

II. Student constructs a wooden form for making a concrete object.

FINISHING

CONTENT TITLE: Executing Landscapes

SUB OBJECTIVE 14: The student will demonstrate ability to construct concrete objects used in a landscape.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates procedure for constructing concrete objects to be used in a landscape.

A. Provide student-made form for stepping stones, bench, etc.
B. Calculate volume of form in cubic feet.
C. Oil inside of form.
D. Add reinforcing steel, if needed.
E. Level all parts of form.
F. Discuss proportions of cement, gravel and water needed to make concrete.
G. Demonstrate tool necessary to mix, tamp, transport and finish cement.
H. Mix cement, sand, gravel and water.
I. Pour mixture into form.
J. Level off excess cement using sawing motions and a good straight board with the crown up.
K. Tamp cement into all areas, making sure steel remains suspended in cement.
L. Allow time for cement to partially set up, then finish to desired surface texture, using proper finishing tools.
M. Allow enough time for cement to completely set up.
N. Demonstrate disassembling technique.
O. Clean forms thoroughly and reassemble for future use.
P. Touch up any discrepancies in concrete.

II. Student constructs concrete object to be used in landscaping project.

FINISHING

OVERALL OBJECTIVE: The student will demonstrate ability to maintain existing lawns by mowing, aerating and fertilizing them, to prune trees, shrubs and other landscape plants and to identify and control plant diseases, pests and weeds.

SOURCES OF INFORMATION

Better Homes and Gardens Garden Book, (Meredith Publishing Co.: 1716 Locust Street, Des Moines, Iowa 50336), 1969.

Better Homes and Gardens Landscape Planning, (Meredith Publishing Co.: 1716 Locust Street, Des Moines, Iowa 50336).

Bush-Brown, James and Louise, America's Garden Book, Charles Scribner's Sons: 597 5th Avenue, New York, New York 10017), 1966.

Snyder, Rachel, The Complete Book for Gardeners, (D. Van Nostrand Reinhold Co.: 450 West 33rd Street, New York, New York 10001), 1964.

Taylor, Norman, Encyclopedia of Gardening, (Houghton Mifflin Co.: 2 Park Avenue, Boston, Massachusetts 02107), 1961.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Mixing ratios
  - Liquid
  - Dry

Science

- Fertilizers
- Herbicides
- Insecticides
- Aeration

Communication Skills

- Related safety - handling toxic materials
- Manufacturer's literature
- Technical literature
  - Diseases
  - Pests
  - Weeds

CONTENT TITLE: Maintaining Landscapes

SUB OBJECTIVE 15: The student will demonstrate ability to mow and aerate lawns.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates mowing a lawn.

A. Select proper mower (reel, rotary, cycle).
B. Adjust height of cutting edge for particular grass or need.
C. Discuss frequency of mowing.
D. Introduce lawn edging and edging tools.
E. Indicate need for familiarity with small engine repair.
F. Stress safety.
G. Demonstrate aerating a lawn.

II. Students mow and maintain an established lawn.

CONTENT TITLE: Maintaining Landscapes

SUB OBJECTIVE 16: The student will demonstrate ability to fertilize an established lawn.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fertilizing lawns.

A. Review the role of elements in plant growth (N, P, K).
B. Discuss and demonstrate characteristics of grass when elements are deficient.
C. Review soil tests for lawns.
D. Select, mix and apply fertilizer in accordance with soil tests.
E. Discuss rate of application.
F. Discuss methods of application.
G. Discuss frequency of application.
H. Demonstrate watering techniques after application.

II. Students fertilize an established lawn.

FINISHING

CONTENT TITLE: Maintaining Landscapes

SUB OBJECTIVE 17: The student will demonstrate ability to select and apply herbicides.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preventing and controlling weeds.

A. Explain to students that proper mowing and lawn care will prevent most weeds.
B. Define weed and list most common ones.
C. Discuss broadleaf, blade-leaf, woody weeds.
D. Explain and demonstrate hand cultivating and chemical methods of weed eradication.
E. Discuss types of weed killers such as selective, non-selective, broadleaf, narrow leaf, woody.
F. Demonstrate applying powders, liquids and mixtures containing fertilizer or seeds.
G. Stress need for complying with application rate and recommendations on label.
H. Stress precautions necessary to avoid polluting nearby streams, underground water and other environmental considerations.
I. Emphasize that herbicides selected should be biodegradable.
J. Discuss the best time of day and year to make application.

II. Students select and apply herbicides for weed control.

FINISHING

CONTENT TITLE: Maintaining Landscapes

SUB OBJECTIVE 18: The student will demonstrate ability to correctly water existing lawns.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates proper watering techniques for established lawns.

   A. Establish a year-round watering system suitable to local weather conditions.
   B. Water only when lawn is showing need for moisture.
   C. Soak soil thoroughly several inches deep.
   D. Discuss advantages of occasional good soakings as compared to daily light sprinkling.
   E. Point out the best time of day to water lawn.

II. Students water lawns.

CONTENT TITLE: Maintaining Landscapes

SUB OBJECTIVE 19: The student will demonstrate ability to prune trees, shrubs and other plants in a landscape.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates pruning trees, shrubs and other plants in a landscape.

   A. Discuss reasons for pruning such as removing dead, diseased or unwanted limbs, improving flowering and fruiting of a plant, beautifying a plant, instigating new, thicker growth of vegetation, removing unwanted growth, such as moss, mistletoe, etc., or pruning growth or transplanted plant to compensate for root injury.
   B. Display and discuss pruning equipment such as saws, lopping and hand shears, extension ladders, climbing ropes and sadals, pole pruners, paints, hammer and chisel, etc.
   C. Demonstrate pruning techniques on trees.
   D. Demonstrate special types of pruning.
   E. Demonstrate pruning and related techniques on plants other than trees and shrubs.
   F. Discuss and develop pruning plan for particular plants, such as roses.
   G. Discuss thinning flowers for larger blooms.
   H. Discuss debudding certain plants for larger blooms.
   I. Discuss picking or pruning old blooms.

II. Students care for trees, shrubs and other plants in a landscape.

III. Students prune a large tree.

CONTENT TITLE: Maintaining Landscapes

SUB OBJECTIVE 20: The student will demonstrate ability to fertilize trees, shrubs and other landscape plants.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses fertilizing trees, shrubs and other landscape plants.

   A. Review fertilizers.
   B. Discuss the best time of year to fertilize plants.
   C. Establish a system of fertilizing various groups of plants in landscape--such as trees, shrubs, roses, annual plants, bulbs, etc.
   D. Calculate amount of fertilizer to apply in accordance with size of plant.
   E. Demonstrate equipment needed and method of application.
   F. Water plants thoroughly after fertilizer application.
   G. Demonstrate use of organic fertilizers.

II. Instructor demonstrates various techniques used to care for trees, shrubs and other landscape plants.

   A. Formulate a suitable watering program for plants.
   B. Demonstrate proper cultivation and weed eradication.
   C. Point out attributes of various plant mulches.
   D. Demonstrate winter protection in climates where deemed necessary.
   E. Discuss placement of plants for best environmental arrangement--sun, wind, cold, etc.
   F. Demonstrate proper transplanting procedures, such as bare rooting, ball and burlapping, heeling in, etc.

III. Students fertilize trees, shrubs and other plants.

IV. Students care for other plants.

FINISHING

CONTENT TITLE: Maintaining Landscapes

SUB OBJECTIVE 21: The student will demonstrate ability to repair existing landscape structures.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates maintenance practices for existing landscape structures.

   A. Review use of construction landscaping tools.
   B. Review landscape construction techniques.
   C. Repair various landscape structures as walks, flower bed borders, fences, patios, paved areas, tables, benches, etc.

II. Students maintain existing landscape structures.

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FINISHING

CONTENT TITLE: Maintaining Landscapes

SUB OBJECTIVE 22: The student will demonstrate ability to identify, prevent and control plant diseases.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates methods of identifying, preventing and controlling diseases of plants.

   A. Define plant disease.
   B. Discuss probable cause of the disease.
   C. Point out symptoms of the various diseases caused by parasitic organisms.
   D. Discuss methods of prevention.
   E. Display and discuss chemicals used to prevent and control disease.
   F. Demonstrate mixing techniques and dilution rates as recommended on label.
   G. Demonstrate various techniques of application.
   H. Stress safety in handling and applying.
   I. Stress danger of harming environment with the use of some chemicals.
   J. Discuss the use of biological control of some diseases.
   K. Provide plants which exhibit disease symptoms caused from environmental conditions.

II. Students identify, prevent and control disease and pests of plants.

CONTENT TITLE: Maintaining Landscapes

SUB OBJECTIVE 23: The student will demonstrate ability to identify and control plant pests.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preventing and controlling plant pests.

- A. Define plant pests.
- B. Identify common pests, such as insects, mites, worms, snails, mammals.
- C. Trace life cycle of pests.
- D. Identify pests at different stages of life. (For example--egg, larvae, pupa, adult, nymph.)
- E. Identify pest by damage to plant.
- F. Discuss methods of prevention.
- G. Display and discuss various chemicals used in prevention and control.
- H. Demonstrate mixing and dilution rates as recommended on label.
- I. Stress safety in handling and applying chemicals.
- J. Stress danger of harming environment through use of some chemicals.
- K. Discuss biological control of some plant pests.
- L. Demonstrate various methods of application.

II. Student demonstrates knowledge of plant pests.

FINISHING

LESSON PLAN SAMPLE

OVERALL OBJECTIVE:	The student will demonstrate ability to mount a mirror using a variety of methods.
SUB OBJECTIVE:	To mount a mirror on a skeleton wood back.
TOOLS AND MATERIALS:	Mirror, 3/4" x 1-3/4" board as long as the perimeter of the mirror, toggle bolts or screws, paint, paint brushes, wood or plastic clips, felt cushions.
I. Preparation	Read the Glazing Manual, p. 16.
II. Presentation	The instructor demonstrates mounting the mirror.
III. Application	The students mount the mirror.
IV. Performance tests	

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FINISHING

construction industry series
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preparation level

VT 102 410

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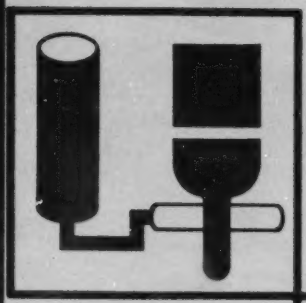

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TEXAS EDUCATION AGENCY

AUSTIN, TEXAS

1975

This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

Exploration Level:

Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

Occupational Preparation Level:

Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
Metal - Student Manual
Metal - Instructor's Guide
Electricity - Student Manual
Electricity - Instructor's Guide
Masonry - Student Manual
Masonry - Instructor's Guide

In addition, there is an Articulation Guide designed for these instructional materials in construction.

Articulation Guide - Construction Industry Series

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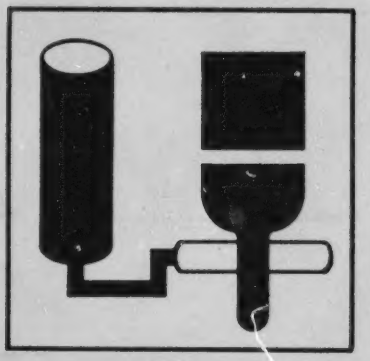
PREFACE

This manual on FINISHING is designed differently than most of the other books in the Construction Industry Series. The reason for this is that FINISHING constitutes six major occupational areas. These areas are:

- Insulation
- Drywall
- Painting and Wallcovering
- Glass and Glazing
- Floor Covering
- Landscaping

Each occupation is discussed in detail in the manual.



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INSULATION

INTRODUCTION

Insulating materials are designed to cut down or prevent the movement of heat, sound or fire from outside a building to the interior or between rooms of a building. There are seven general types of thermal insulation, and each of them has its own distinct method of installation. They are: Batts and blankets, fill-type insulation, urethane-or polystyrene-block insulation, reflective insulation, foamed-in insulation, spray-on insulation and corrugated insulation. In this manual will be outlined the installation procedures used with these different insulating materials.

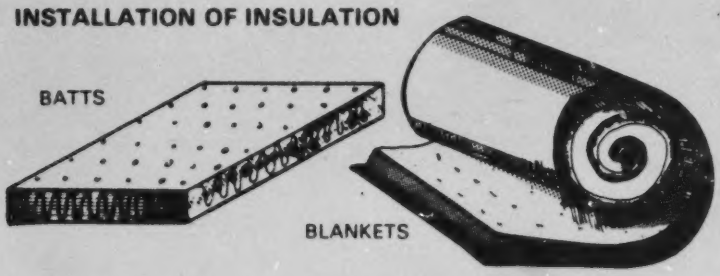
CALCULATING INSULATION REQUIREMENTS

Before any insulation is installed let's look at some of the basic calculations which must be made before thermal insulation is applied. No matter what sort of insulation is being considered, there are certain values which insulators will refer to over and over again. These terms refer to amounts of heat which pass through a given space or a given material in a given time. Usually heat is measured in BTUs, or British Thermal Units. The BTU is the amount of heat needed to raise one pound of water one degree. The second major term is the "C" value. C refers to the amount of heat in BTUs which will pass through one square foot of material in one hour with one degree of temperature difference between the two surfaces. A third term is "K" value. The K value refers to the amount of heat in BTUs which goes through one square foot of material one inch thick in one hour when there is a one degree temperature differential between the two surfaces. A fourth term is "R" value. The R value measures the heat resistance per hour per degree of temperature difference in BTUs. This means that the R value measures how heat resistant a given material is. The higher an R value any given material has, the better an insulator it is. The formula for calculating R values is 1/K or 1/C. A fifth term is "U" value. The U value measures the total amount of heat transmitted per square foot per hour per degree of temperature difference between two surfaces which have several layers.

After long experience insulators have standardized U and R values for ceilings, walls and floors over unheated spaces. These values are sometimes referred to as "the all weather comfort standard," the "moderate comfort standard" and the "minimum comfort standard." Depending on climate, different amounts of insulating materials will be needed to hold heat in a house. Using the U and R values, and considering the climate, a rough estimate of

insulation can be made. Then an insulator measures the spaces to be insulated. Usually these measurements are made with a flexible metal tape or with a folding rule. This information should be carefully noted in a pocket notebook. The insulator is now ready to install the insulating materials.

INSTALLATION OF INSULATION

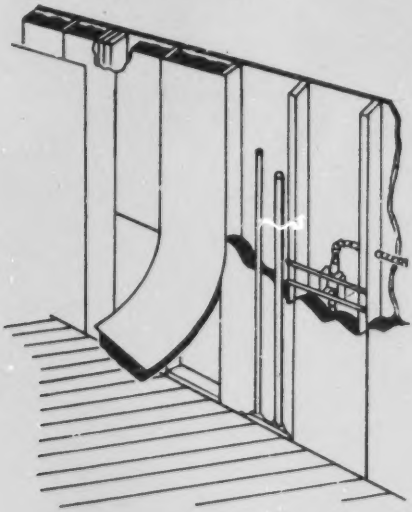


• *Batts and blankets.* Batts and blankets are made of felted mineral wool or glass wool. The wool is packaged in several ways. Sometimes it is completely enclosed in a heavy paper envelope; some batts and blankets have paper on one side only. Still others have vinyl, cardboard or wire mesh on one or both sides. A few have no covering whatever; they are simply rolls of mineral wool. When batts and blankets do have some sort of backing or covering material, they usually have stapling flanges which stick out on both sides of the batt so that the insulation may be easily stapled to studs and joists. Batts and blankets are sold in a wide range of thicknesses and widths. The standard thicknesses available are 1, 1-1/2, 2, 3 and 6 inches. The standard widths are 16, 20 and 24 inches. The difference between batts and blankets is that blankets are sold in long, continuous rolls while batts are no more than 48 inches long. Blankets are used where large areas need to be insulated. Such areas might be sidewalls, floored attics, crawl spaces, the space above suspended ceilings and the

like. Blankets and batts are installed in the same way by stapling them to adjoining studs.

The first step in installing blankets is to measure and cut the required length of blanket. The insulator measures off with a tape measure or folding rule the length of blanket which will be required. This length is marked off on the floor with chalk. The blanket is unrolled and aligned with the marks on the floor. Insulation installers allow an extra 2 or 3 inches and then cut the blanket carefully. The tools used to cut blankets are fine-toothed, cross-cut handsaws, shears or large knives. A small strip of mineral wool is removed at each end to leave space for a stapling. When working with batts and blankets, the insulator should wear long sleeved shirts and gloves, because the mineral wool or glass wool fibers of batts and blankets are very irritating to the skin.

Once the blanket is cut it is ready to be stapled to the wall or ceiling. Batts and blankets are stapled up in the same way. The insulator starts at the ceiling and staples the top of the blanket to the plate, and staples the material every 6 or 8 inches. Once the top of the blanket is securely fastened, the rest of the blanket is

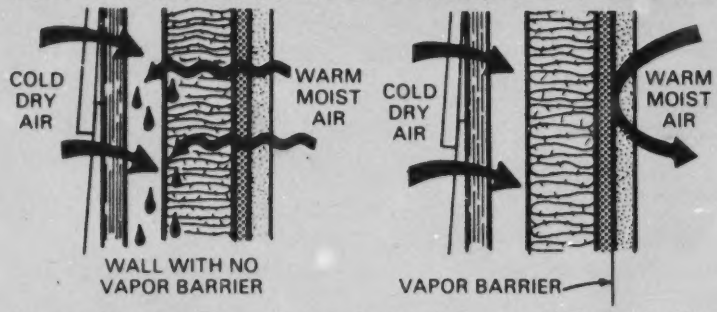


wedged securely in place. The flanges on both sides should be stapled at 12 inch intervals. If batts are used, the second batt is wedged securely against the first one and the top flange is stapled, once again, at 6 inch intervals. The insulator continues with this process until the bottom is reached. The bottom batt is stapled securely to the adjoining batt, to the studs on both sides

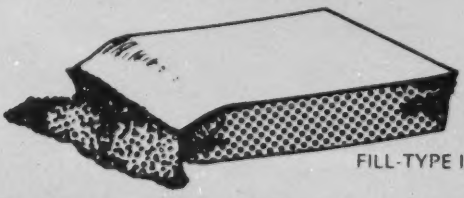
and against the bottom sole plate. Batts and blankets are threaded around obstacles such as pipes and conduits. Electrical boxes must not be covered. Batts and blankets are fitted around them, or, as a last resort, the insulator may make cut-outs to fit around the boxes.

Occasionally, insulators will be called on to install batts and blankets on drywall surfaces or in odd spaces other than those of the usual framing. In this situation the stapling flanges are stapled directly onto the drywall surface. Once the major parts of the wall have been covered, the odd spaces above and below doors and windows are covered. Odd pieces, cut off from the longer batts, can be used to insulate these spaces.

Once the batts or blankets have been installed, a vapor barrier is put up over them. Vapor barriers are sheets of polyethylene or metal foil which prevent the flow of water vapor into or out of the



insulated space. These sheets are stapled over the batts to the studs at 6 inch intervals. Each sheet should overlap the sheets adjoining it by at least 3 inches. The vapor barrier goes behind obstructions such as electrical outlets, plumbing pipes, conduits and the like. If necessary, cut-outs may be made, and the vapor barrier can be sealed and caulked to the obstruction. The installation of the barrier must be done as carefully as possible to make sure that it is air and water tight.



FILL-TYPE INSULATION

• *Fill-Type Insulation.* Fill insulation is composed of small, light pebbles of either perlite or vermiculite. Perlite is a volcanic rock which contains water. Vermiculite is a rock which contains many

tiny mica. Both of these materials come from certain kinds of rocks which are crushed into pebbles and then heated to about 2000°F. As they are heated, droplets of water contained in them turn to steam and expand. The pebbles, instead of exploding, expand like popcorn. This leaves light, air-filled pebbles which make an excellent insulating material. Vermiculite and perlite are blown into wall cavities or into attic spaces with blowing machines that look and operate very much like vacuum cleaners going in reverse. Another type of fill insulation sometimes used, is loose strands of glass wool or mineral wool. Loose fill insulation is usually installed on horizontal surfaces like ceilings; however, it is sometimes blown into finished wall cavities which are being insulated as part of a remodeling job. Installing loose fill insulation in ceilings is a simple process. First a vapor barrier, generally polyethylene film, is installed. If it cannot be placed on the underside of the ceiling, it is draped loosely from joist to joist. The fill is poured or blown in between the joists. The insulator should wear gloves and goggles while blowing the fill. Once the spaces between the joists have been filled, the insulation is leveled. If too much insulation has been blown in, it should be pushed into corners and along the outside walls.

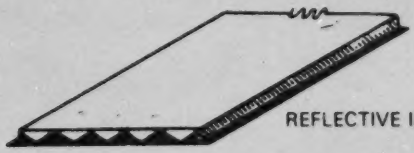
Sometimes hollow walls are filled with loose fill insulation. This is somewhat more difficult, because it is hard to be sure that the insulation is filling the spaces in the walls completely. Almost any obstacle in the wall will create large air pockets. In order to avoid this as much as possible, the wall should be filled from the bottom up. Holes are drilled in the wall fairly close (3 or 4 feet) to the floor and insulation blown in. Then the upper parts of the wall close to the ceiling are drilled and insulation blown in. Finally, the wall is tapped to settle the insulation and fill whatever air pockets there are.

BLOCK INSULATION

• *Urethane- or Polystyrene-Block Insulation.* These blocks are millions and millions of bubbles of air in a sort of honeycomb network. Rigid block insulation is used for roof decks, masonry walls, cavity walls and large walk-in refrigerators. Blocks of foam insulation are not too difficult to measure, cut and install. On spaces smaller than the blocks, the exact lengths and widths needed are marked off with a pencil and straightedge. Then the block is cut with a sharp knife or with a fine-toothed, cross-cut handsaw. Once the blocks are measured and cut, they are

attached to walls. The way they are attached depends on the type of wall. For masonry cavity walls, the first thing is to make sure they are plumb and true with a level. Then the insulator checks to see that all mortar joints are full. Any cracks or crevices are filled. The interior and exterior walls should be tied together with metal ties. The slabs are attached to the interior wall with adhesive applied to the board along the outer 2 inches of the perimeter. The boards of insulation are butted firmly against each other and against the metal ties. (Petroleum-based adhesives tend to melt polystyrene and polyurethane so they should not be used.)

Foam insulating blocks may be attached to plaster-base walls. Once again the actual application process is relatively simple. Adhesive is applied to the outer 2 inches of the perimeter of the block and the exposed edges of the adjacent blocks. Then the blocks are butted into place. In small spaces, such as those above and below doors and windows, small pieces are used. These pieces are carefully measured and cut with a sharp knife or with a fine-toothed, cross-cut handsaw.



REFLECTIVE INSULATION

• *Reflective Insulation.* Reflective insulation is generally made from aluminum or copper foil. The shiny surface reflects heat. Aluminum foil is sometimes attached to paper and folded into accordion-like blankets. Copper foil is often attached to both sides of a thin paper cone. Sometimes foil is attached to the backs of blankets or batts. This gives two sorts of insulation in one. Reflective insulation is often used in stud, rafter and joist spaces to insulate walls, roofs, ceilings and floors.

• *Foamed-In-Place Insulation.* This material has properties similar to those of urethane and polystyrene slabs except that foamed-in-place insulation forms a continuous coating on a wall. It is made by mixing polyisocyanate and a polyester resin. The insulation then is applied by spraying or blowing. The two basic ingredients are drawn out, measured and mixed by machine. The mixture reacts and foams to fill a precalculated space. A number of coats are applied.

• *Sprayed-On Insulation.* There are a number of different materials used in sprays. These materials include urethane, vermiculite with a Portland cement binder, perlite with a gypsum binder and asbestos fibers with an inorganic binder. This sort of

insulation seals cracks and crevices. Sprayed asbestos and urethane and polystyrene blocks are frequently used to insulate pipes carrying very hot or very cold liquids or gases.

• *Corrugated Insulation.* This is made from paper formed in such a way that it contains air pockets. Sometimes multiple corrugations are made into sheets from 1 to 4 inches thick to be used as partitions in non-loadbearing walls.

TOOLS AND EQUIPMENT

The tools and equipment used in asbestos and insulation work include both standard hand tools (hammers, tape rules, etc.) and specialized insulation tools. The following are some of the more commonly used tools and equipment.

Blower—a device for forcing compressed air through a hose to spread and distribute loose-fill insulation.

Brushes—in insulation work, brushes are often used for spreading adhesives over insulation board.

Hacksaw—a frame saw with interchangeable blades used for cutting light construction material such as plywood and insulating materials.

Paddles—small flat boards used for stirring liquids or for applying adhesives to the back of insulating boards.

Portable circular saw—a hand-held power saw with a circular cutting wheel of thin steel. Most varieties may be adjusted for cross-cutting or for ripping.

Scissors and shears—large, heavy-duty steel scissors and shears are frequently used to cut batts and blankets.

Spray equipment—this equipment forces pressurized insulating materials through a nozzle and on to the surface to be insulated.

Staple guns (hand)—a stapler built into a hammer, used primarily to install batts.

Staple guns (pneumatic)—a stapler which uses compressed air as the power source. Pneumatic staplers are used primarily on large jobs where mass-stapling is required.

Tape measure—a (normally retractable) steel measuring tape from 6 to 300 feet in length.

Trowel—triangular-shaped, flat bladed steel device used for spreading mortar and plaster, or, in insulation work, for spreading adhesives onto the backs of insulation boards.

AFTER GRADUATION

Toward the end of your senior year you will need to make a decision as to whether you want to seek additional training in asbestos and insulation or go directly to work. Even though you probably have a fairly accurate assessment of your capabilities, it would be wise to discuss your next move with your instructor or counselor.

If you decide to go directly to work, you will need to ask yourself several questions. Where do I want to locate? What kind of company do I want to work for? What type of working conditions do I desire? As much as possible, know what you most want out of going to work. Use this information as a goal and set your mind to achieving it.

Going Directly To Work

Most asbestos workers are employed by insulation contractors in new industrial and commercial construction. A substantial number are employed in the alteration and maintenance of insulated pipework in chemical plants, petroleum refineries, atomic energy installations and other industrial establishments which have extensive steam installations for power and heating. Some large establishments which have cold storage facilities also employ asbestos workers for maintenance work.

Employment of asbestos and insulating workers—estimated at about 25,000 in 1970—is expected to increase moderately through the 1970's. In addition to the job openings resulting from the growth of the trade, other opportunities will arise from the replacement of workers who transfer to other fields of work, retire or die. Retirements and deaths alone will result in a few hundred job openings annually through the 1970's.

Employment growth will result mainly from the anticipated large rise in the volume of construction activity, particularly of commercial and industrial buildings. The increasing use of pipe in numerous manufacturing processes, and in air conditioning and refrigeration installations will expand the need for asbestos workers in installation and maintenance work.

Asbestos and insulating workers spend most of the workday on their feet, either standing, bending, stooping or squatting. Working from ladders in tight or nearly inaccessible spaces when covering pipes and ducts may be necessary. Removing old insulation before installing new materials may be particularly dusty and dirty.

A large proportion of the workers in this trade are members of the International Association of Heat and Frost Insulators and Asbestos Workers.

GLOSSARY
INSULATION

Air change—the amount of air flowing into or out of a building relative to the total volume of air in the building.

Air space—the space between the insulation facing and the interior or exterior wall covering.

Batt—a mineral or glass fiber insulation roll that has been precut to a specific length for fast installation.

Blanket—a packaged roll of mineral or glass fiber insulation which can be cut to specific lengths on the job.

Blowing wool—loose mineral or glass fiber insulation intended to be used with pneumatic blowing machines.

BTU—the British Thermal Unit. One BTU is the amount of heat needed to raise one pound of water one degree Fahrenheit (specifically from 63° Fahrenheit to 64° Fahrenheit).

Condensation—the change of a vapor into a liquid by heat loss.

Dew point—the air temperature at which water vapor begins to condense.

Double glass—a type of window or door unit in which two panes of glass are used with a sealed air space in between.

FHA minimum—the minimum acceptable amount of insulation which may be installed in a house to qualify it for an FHA loan.

Fiberglass—material made by flowing sheets of melted glass into an air stream creating thin threads of glass.

Insulation—any material which slows down heat transfer.

Perlite—an inorganic mineral which is often crushed and then expanded by heating, for use as a loose-fill insulation material.

Pouring wool—loose filler insulation, packed in bags, which is used in areas where it can be hand poured to any desired thickness.

R factor—the resistance of any given substance to heat transfer.

Radiation—heat transfer by electromagnetic waves from a warm to a cool surface.

Rock wool—a fiber insulation made by melting a certain type of slag at extremely high temperatures and blowing air and steam into the stream to form extremely thin filaments which are then spun into a mat.

U factor—the amount of heat which will transfer from one edge of a total construction assembly to the other, such as a wall, a ceiling or a floor.

Vapor barrier—a continuous layer or film of some sort which retards the transfer of water vapor. It is applied to the inner heated edge of the thermal insulation of a wall.

Vermiculite—an inorganic granular mineral used in loose-fill application.

APPENDIX
INSULATION

Distributive Education Instructional Materials Services. Division of Extension, *Building Materials Technology and Selling*, (University of Texas: Austin, Texas 78712), 1972.

Smith, R.C., *Materials of Construction*, (McGraw-Hill Book Company: 1221 Avenue of the Americas, New York, New York 10020), 1973.

Wagner, Willis H., *Modern Carpentry*, (Goodheart-Wilcox Company Inc.: 123 W. Taft Drive, South Holland, Illinois 60473), 1969.

ADDITIONAL SOURCES OF INFORMATION

Acoustical and Insulating Materials Association
205 W. Touhy Ave.
Park Ridge, Illinois 60068

National Insulation Contractors Association
8630 Fenton St. Suite 506
Silver Spring, Maryland 20910

International Association of Heat and Frost Insulators and Asbestos Workers
1300 Connecticut Avenue, N.W.
Washington, D.C. 20036

DRYWALL

INTRODUCTION

The great strides made during the past decade in the drywall industry have resulted in new types of job opportunities. Most manufacturers of drywall products are constantly on the lookout for new and better ways of doing things. Developments in the industry have stemmed from changes in metal finishes, architectural design, changes in fire and local building codes and new vinyls and fasteners.

There are a number of new job opportunities available which are related to the traditional drywall applicator. Previously the drywall applicator was required to do a part of all wallboard installation, accessories, taping, floating and finishing. With the increasing demand for speed in construction, large installation jobs and the variety of materials currently used, job specializations have become an important part of drywall construction. Specialized occupations include the drywall applicator, nailer, taper, drywall sanders, taping machine operators and modular drywall installers.

The following is a description of the previously mentioned areas of specialization in drywall application as found in the *Dictionary of Occupational Titles:*

Drywall applicators' (842.884) duties usually consist of wallboard handling; preparation of sidewall and ceiling; scoring and snapping; cut-outs for openings; bedding of joints; securing wallboard by nails, screws and adhesives; taping of joints; floating of joints; finishing joints; applying metal or wood trim; water proofing of bathrooms and powder rooms; application and finishing of one layer, two layer, or solid non-loadbearing walls. The drywall applicator is sometimes called upon for estimation of materials for new construction or repairs.

The taper (842.884) is primarily involved in the application of joint compound and bedding of joints. Taping is then applied manually or by an automatic dispenser and the edges feathered by a trowel or wide putty knife for a smooth surface.

Drywall sanders (840.887) usually perform sanding activities only. These duties begin immediately after joints have been taped, topped, and thoroughly dried. Drywall sanding is usually by electric and/or manual method.

In this manual let's first consider what Drywall is, second, look at the basic operations of a drywall installer, and then look at six basic drywall jobs: Installing drywall over framing; installing drywall around high moisture areas; back-blocking; installing decorative drywall; installing non-loadbearing partitions; attaching drywall to columns and I-beams.

DRYWALL

Drywall, or gypsum wallboard, provides a convenient covering for framing. It is excellent as a base for plaster, paint or wallpaper. Wallboard has the advantages of being light, fire resistant and relatively inexpensive. It is also fairly easy to install. Gypsum wallboard consists of panels of crushed and heated (or "calcined") gypsum rock placed between two sheets of heavy paper. The front sheet of paper is smooth and heavy so that many different finishes may be applied. The back sheet is a gray, tough paper designed to hold the gypsum core together. Sometimes a sheet of aluminum foil is attached to the back to serve as insulation. Wallboard comes in four standard thicknesses—1/4, 3/8, 1/2 and 5/8 inches.

Although nine different types of wallboard are manufactured, the two major types are wallboard and backing board. Wallboard is placed over and fastened to the framing of a building. It is then painted or wallpapered. Backing board is covered on both sides with a strong gray paper. It should not be used as an exposed surface, but it is very good as backing material for plaster or for ceramic tile. Both types of wallboard are applied in nearly the same way. There are several distinct steps in the application of drywall.

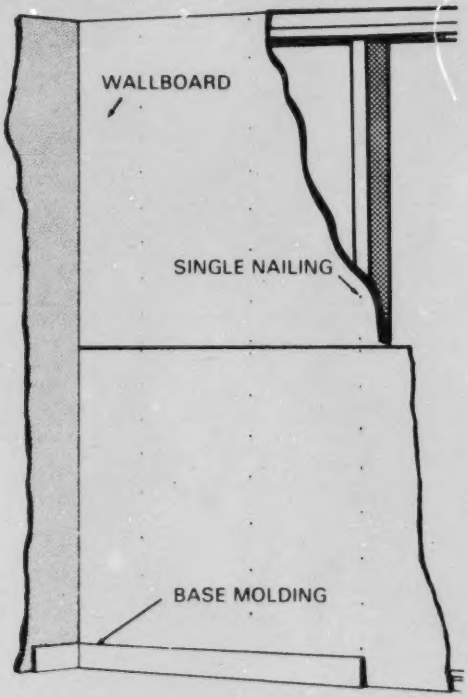
OPERATIONS OF A DRYWALL INSTALLER

One of the first things a drywall installer needs to know is how to cut wallboard. Drywall installers use a special knife to cut drywall. This knife, called a utility knife or a "rock knife," has a small, angled, very sharp triangular blade. Installers also use sharp-edged saws with fine teeth. These keyhole saws are used to make small cuts and right angle cuts in wallboard. Wallboard saws are larger, have coarse teeth and are used to make larger openings such as those for windows. When circles need to be cut, there are wallboard circle cutters. Circle cutters have a cutting blade attached to an adjustable arm which revolves around a fixed center.

When the drywall installer gets ready to install gypsum wallboard, the first step is to measure the space onto which the wallboard will be placed. The wallboard is carefully measured and marked with a straightedge. With a utility knife the drywall installer cuts deep into the wallboard along the marked line. The major part of the wallboard should be firmly supported. The drywall installer places his hands close to the scoring and presses down firmly on the overhanging section of the board. Then the back lining of paper is cut off.

Surface Preparation and Installation

Before wallboard is put up, the wall should be checked to be sure that it is in suitable shape for wallboard application. The framing should be well-aligned and protruding nails hammered back into place. Recessed parts of the framing should be shimmed into place. Framing which sticks out should be planed down. Twisted framing should be planed down, or, if this is not possible, the framing should be reinstalled. Once the framing is properly aligned, the wallboard can be installed. Wallboard is attached to fram-

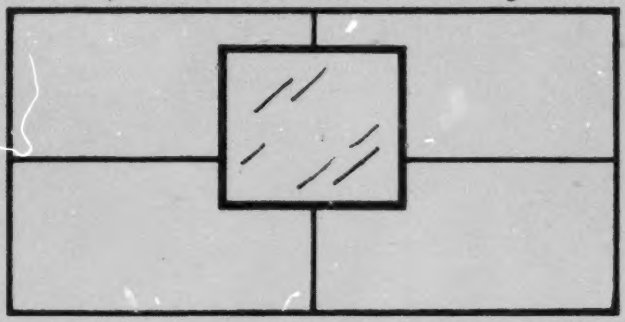


ing with nails or screws. Usually 5d (penny), 6d and 7d drywall nails are used. The nail head is slightly cupped so that it does not cut the paper when driven at a slight angle, and the shank is chemically etched. The nail is driven in flush or slightly sunk into the wallboard, but it should not cut the paper. The final hammer tap should create a slight "dimple" or cut in the wallboard in which the nail rests. Nails are placed in rows no more than seven inches apart on ceilings and eight inches apart on walls. Screws may also be used to attach wallboard, usually a Phillips head screw 1-1/4 inch long. Although screws can be attached man-

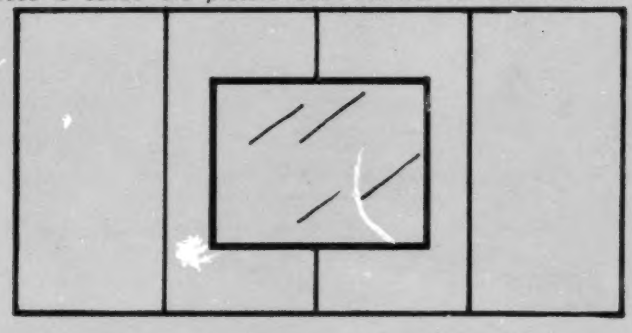
ually, an electric screwdriver is usually used because it is much faster. Electric screwdrivers operate very much as do electric drills, except that a screwdriver attachment is used instead of a drill attachment. Wallboard can be attached more firmly with screws than with nails. Therefore, screws on ceilings may be 12 inches apart and wall screws can be 16 inches apart. Screws should be flat against the wallboard without cutting the paper.

Wallboard can be laid out and fastened to walls either horizontally or vertically. Horizontal layouts are made with wallboard so that its length is at right angles to the framing. The vertical layout is made so that the long side of the wallboard is parallel to the framing studs.

Wallboard is installed on the ceiling first. It should be laid out so that no joints fall on the edges of windows, doors and so forth. On wall installations, cut-outs must often be made for windows. There are ways to do this. One is called the *horning method.* The



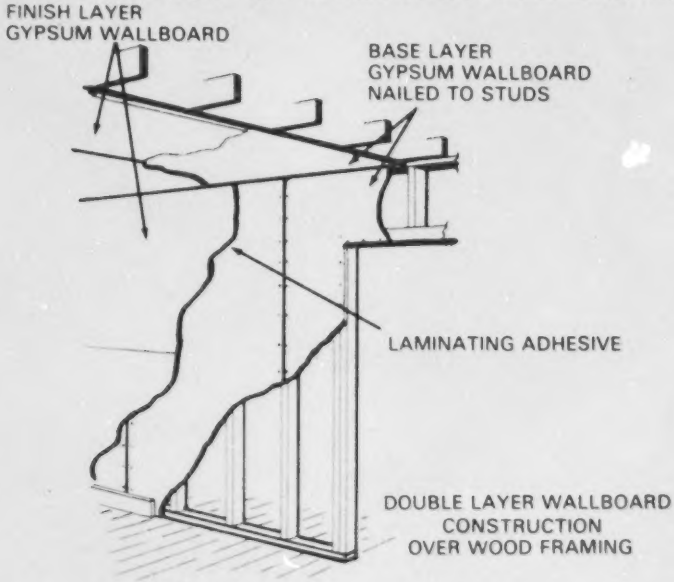
drywall installer measures out the size of the piece needed to fit over a door or window or under a window. The dimensions are drawn on pieces of wallboard. The vertical lengths are sawed; the horizontal lengths are scribed with a rock knife. Then the piece is broken out of the wallboard. A second method for cutting small pieces is called the *picture cut method.* In this method the



horizontal line is scribed with a rock knife; the vertical lines are sawed out.The method requires cutting a rectangular hole within a sheet of wallboard. The dimensions of the piece to be cut are scribed on the face of the wallboard with a T-square; on the back the dimensions of the piece are scribed 1/8 inch larger. Both scribings are done with a rock knife. Then the face is tapped gently with the hand to break the gypsum core of the wallboard. Finally the whole piece will fall out.

BASIC DRYWALL JOBS

1. Often two layers of wallboard are applied over framing to give more strength. The first layer is attached to the framing with nails or screws. The second layer is attached with an adhesive. The

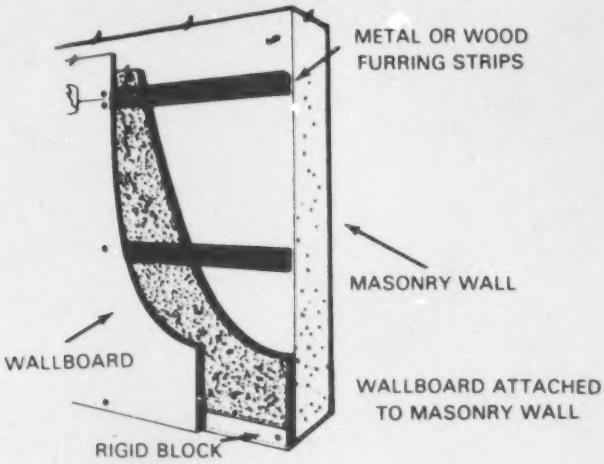


adhesive is applied with a trowel to the entire back surface. Then the second layer is placed so that it overlaps the joints on the first layer by about ten inches. It is pressed firmly to the base layer to ensure a good fit. It may be necessary to nail the outer layer to the base layer temporarily. Any excess cement squeezed out between joints is wiped off. After two days the temporary nailing can be removed.

Once drywall is in place, the joints between drywall panels are taped to conceal them. Often wallboard with a tapered edge is used so that it will be easier to install a bedding compound and

tape. Bedding compounds are used to fill the joints between panels and to fill the depressions of the beveled edges. Bedding compounds are applied with a concave trowel. Tape is centered over the joint and pulled so that it does not buckle or wrinkle. A knife is drawn along the tape to smooth it. A second coat of compound is applied over the tape, smoothed and feathered out slightly over the edge of the tape. When this coat dries, a third coat is applied and its edges feathered out two inches beyond the tape. Finally, the surface of the bedding compound is sanded down until it is smooth.

Where wallboard is to be attached over masonry surfaces or over wood surfaces that are too far out of alignment to be corrected, furring strips are put up as surfaces to which the wallboard can be attached. Furring strips, which are strips of lumber 1 x 2 inches, are attached perpendicular to the framing; that is, they run parallel to the floor. Where they are applied to framing members they are nailed up in the usual fashion; on masonry surfaces they are fastened with powder-actuated equipment. Powder-actuated equipment operates much like a pistol; it fires a fastener into hard-to-pentrate surfaces. Once furring strips are up, the wallboard is attached to them as it would be attached to framing studs.



One variation on furring strips is used on ceilings. In this arrangement furring strips are attached to ceiling joists with metal clips. This provides a great deal of sound and heat insulation. Clips are attached to wooden joists and then attached to (and hold up) wooden furring strips. Furring joints and wallboard joints should be staggered at least 12 inches. Although clips may be nailed to

joints, screws are much better. As the wood shrinks, nails will tend to pop out. Furring strips should be attached to clips with screws. Then the wallboard can be attached to the furring with 1-1/4 inch Phillips head screws. Screws are usually driven in with electric screwdrivers. The screw is inserted into the head of the screwdriver, and the screwdriver control head is adjusted to drive the screw to the proper depth. Once the proper depth is reached, the screwdriver stops.

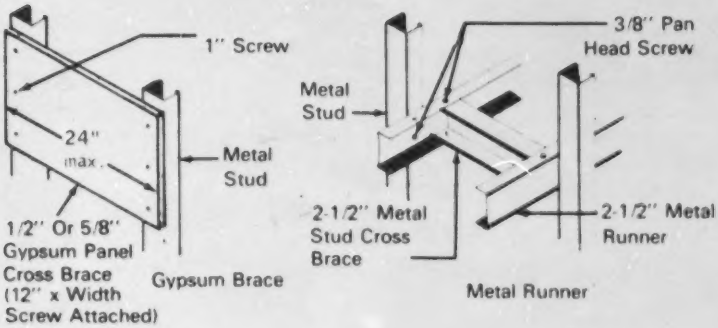
2. Sometimes drywall installers must install wallboard around tubs, showers and other high moisture areas. In these places the first step is to check the framing to see that it is level and that with wallboard added it will reach the lip of the tub, shower or lavatory. If it will not, then furring strips must be measured, cut and installed so that the wallboard will be flush with the outer lips of the fixtures. Then 1/4 inch spacer strips are placed exactly along the edges of the fixtures. Finally the wallboard is fastened. If tile is later going to be applied to it, nails are placed 4 inches apart between centers; screws are applied 8 inches apart between centers. The wallboard is laid out horizontally rather than vertically. The factory paperbound edge is placed touching the spacer strip. If possible, water-resistant wallboard should be used. Openings around pipes are filled with caulking compound but the 1/4 inch spacing around showers and tubs is not filled.

3. Sometimes it is necessary to *back-block* wallboard to prevent its buckling or forming ridges. Usually this must be done in places where high humidity would tend to warp the wallboard. Back blocking is done by taking blocks of wallboard about 8 inches wide and just long enough to fit between joists. Joint compound or joint adhesive is spread over one side of the blocks with a trowel or putty knife. The block is placed so that half its width is on one piece of wallboard and half of it overhangs the joint. Then the next piece of wallboard is laid onto the block. The block must fit evenly on to each piece of wallboard it joins.

4. Some wallboard has decorative designs on it and is designed to serve as a finished wall. Frequently, wallboard such as this has a layer of vinyl attached to it. When making cutouts, the vinyl is cut with a knife, and the coreboard is cut from the back to keep from tearing the vinyl away from the wallboard. Decorated wallboard is applied vertically with adhesives, and the adhesive is applied to within 6 inches of the end of each stud. At joints, two beads are applied, one for each sheet. Another way is to apply predecorated wallboard to a previously attached wallboard panel. The adhesive is spread over the face of the backing board with a notched trowel or knife. The adhesive beads run to within 3 inches of all panel edges. The decorated wallboard is applied and struck with

the fist or with a soft rubber mallet. The blows are spaced about 16 inches apart. Glue is washed off the surface with a mild detergent. Then the panel is rinsed and sponged dry.

5. Drywall is also used to form *non-loadbearing partitions* between two rooms. Non-loadbearing means that the partition does not help support the roof. These partitions are used to separate rooms and to divide spaces. Drywall partitions are particularly useful, because they reduce the sound transmitted and resist the spread of fire. For these two reasons designers often specify drywall partitions in a house. The first step in installing a partition is to make sure the room is reasonably square. The next step is to install metal runners. Metal runners are used to hold the wallboard



in place and connect it to the floor and ceiling to keep it in place. The manufacturers of metal runners usually provide clear instructions about how they should be installed. Gypsum strips are used as studs to keep the wallboard in place. The studs are attached to the runners with screws. Usually the ribs are 1 inch thick and 5 inches wide and run from floor to ceiling. The wallboard used is four feet wide and runs from floor to ceiling. It is attached to the runners with 1-1/4 inch Phillips screws and attached to the ribs with adhesive.

6. Wallboard is often attached to columns and to I-beams. The first step in doing this, as in any other wallboard installation, is to measure the columns. The wallboard should be cut so that each piece overlaps the previous one by one board width. The application starts by holding four pieces in place, butted against each other and held with adhesive. A wire is tied tightly around the columns holding them in place. Then the rest of the column is covered. A second, and, for added fire resistance, a third layer should be applied. These are attached with screws or nails and adhesive.

TOOLS AND EQUIPMENT

Carpenter's Level - A spirit level set in an aluminum or wood frame used to check horizontal and vertical alignment.

Caulking Gun - A dispenser used to spread caulking compound.

Ceiling Jacks - Factory made or constructed lifts used to raise and hold wallboard to the ceiling until nailed.

Chalkline Reel - A reel, string and chalk powder enclosed in a small refillable box used to mark straight lines for layout.

Circle Cutter - A steel blade mounted on a calibrated rod easily adjusted for cutting perfect circles in wallboard.

Claw Hammer - The hammer most used by carpenters which has curved claws designed for removing nails and is available in various sizes (16 oz. most common).

Combination Square - A square with an adjustable blade, spirit level, scribe and 45 degree and 90 degree marker ledges. It is used to scribe parallel lines, mark 90 degree and 45 degree angles and measure and check for squareness.

Cross-Cut Hand Saw - A saw used to cut wood across the grain.

Flat Trowels - A flat metal tool normally used by concrete finishers. In wallboard installation it is used to apply and finish joint compound.

Framing Square - A flat metal measuring device with a body of 24 inches and a tongue of 16 inches. Various tables are engraved on it for use in framing operations.

Grooved Trowel - A flat metal tool with serrated edges used primarily to leave ridges on a surface so that an adhesive may be applied.

Hack Saw - A steel frame saw with changeable blades used for cutting metal.

Hand Brace - A tool which holds the bit securely while boring a hole.

Keyhole Saw - A short blade saw with a sharp point used for cutting small openings in wallboard.

Markers - A carpenter's framing pencil or crayon.

Mechanical Adhesive Spreader - A mechanically operated adhesive dispenser used to spread mastics evenly on sidewalls and ceilings.

Mortar Board - A square piece of wood or metal with a handle on the lower side used to carry concrete or joint compounds.

Nail Set - A tapered steel tool with a concave point used to countersink nails.

Plumb Bob - A pointed piece of metal attached to a string for use in vertical leveling.

Pneumatic Screwdriver - An air-driven screwdriver.

Pneumatic Staple Driver - An air-driven stapler.

Portable Electric Drill - A hand-held, electic-powered drill.

Portable Electric Saw - An electric, hand-held power saw used for straight cutting of wood and other materials

Portable Sander - A hand-held belt or disc sander driven by an electric motor.

Portable Scaffolding - Wood or steel framing easily assembled and disassembled and used to support walking boards.

Powder-Actuated Nailer - A nailer activated by a 22 or larger caliber cartridge used to secure building material to a concrete slab or wall.

Power Screwdriver - A hand-held electric driven screwdriver.

Putty Knife - A thin metal blade of various widths used to spread putty and mastics.

Rasp - A coarse metal file used to plane and trim wood edges.

Roll Scaffold - A movable, elevated structure on wheels used for the support of workmen and materials.

Sheet Metal Shears - Heavy metal scissors used to cut sheet metal.

Side Cutters - Pincers used to hold, cut, twist or bend wire or small metals.

Steel Tape - A retractable steel tape commonly 6 to 12 feet in length.

Stilts - A short, adjustable extension buckled onto the feet to aid in reaching the ceiling or other high places.

Straightedge - A rigid wood or metal strip used to mark or score.

Tape Box - A device constructed of sheet metal with a box dispenser for embedding compound. It automatically applies compound to the tape when pulled through the lower portion.

T-square - A calibrated straight edge and T-square combination used as a guide for making butt end cuts.

Tool Pouch - A holster made of heavy leather attached to a belt and used to carry tools.

Twist Drill - A single-piece, metal drill bit with spiral grooves for boring or drilling small holes.

Utility Knife - A device which contains a short replaceable blade similar to a single edge razor. It is used for scoring wallboard.

Wallboard Hammer - A hammer with a convex, round, checkered head, a wedge-shaped blade and a nail pulling eye.

Wallboard Lifter - A wedge designed to raise wallboard into position against a wall for nailing.

Wallboard Saw - A five-point saw used for straight cutting of window and door openings.

Wood Chisel - A flat metal tool with a sharp end used to shave or cut away wood.

Zig Zag Rule - A folding rule, 6 feet in length, normally constructed of wood.

SAFETY CONSIDERATIONS

Good drywall installers have work habits and practices that are safe for both themselves and their co-workers. They must have a thorough knowledge of the proper use of their tools and equipment and be aware of all safety practices while carrying out their duties on the job.

There are Federal and State safety codes which govern the conditions by which workers carry out their jobs, and in some areas these codes are rigorously enforced. On most jobs, whether large or small, it is the employer's responsibility to see that safe working conditions and practices prevail at all times. Drywall personnel should constantly be on the alert for unsafe conditions and attempt to correct safety hazards or at least inform employers or supervisors of them. In most States an employee cannot be required to carry out a job if it violates safety laws and, therefore, cannot be discharged or laid off for refusing to perform unsafe tasks.

The wallboard installer often feels that the job is safe in comparison to other construction jobs. The installer must keep in mind, though, that a serious accident could occur simply because of a twist of an ankle, a wrong technique of lifting or a faulty tool.

Wallboard installers should be aware of a number of safety hazards and precautions. Clothing should not be loose-fitting, have torn places or cuffs because of the danger of becoming hung on nails or other projections. Shoes should have safety toes and thick soles to help prevent foot punctures. Gloves should always be worn when handling sheet metal.

The job site should be carefully checked for hazardous conditions. There must be adequate lighting at all times. Openings in the floor, in sidewalls, on upper stories, staircases, shafts and elsewhere require guardrails. Equipment, tools and scrap material should not be left underfoot. Wet joint compound, grease or water spills should be cleaned up immediately to prevent falls. All scaffolds and ladders should be tested for weaknesses prior to mounting or loading with materials. Loose materials, tools and debris should not be left on scaffolds or ladders as they are easily knocked off and could cause injury to someone below.

Common sense in handling tools and materials can prevent many accidents. Workers should have a good knowledge of all electric and powder-actuated tools. Power equipment should be checked thoroughly and often for poor connections and breaks in cords and lines. Caution should be taken while handling wallboard, particularly in obtaining good footing and a good grip. When lifting or lowering wallboard, the back should be kept straight and the leg muscles used. During windy conditions, two persons should carry one piece of wallboard.

AFTER GRADUATION

Toward the end of your senior year you will need to make a decision as to whether you want to seek additional training in drywall application or go directly to work. Even though you probably have a fairly accurate assessment of your capabilities, it would be wise to discuss your next move with your instructor or counselor.

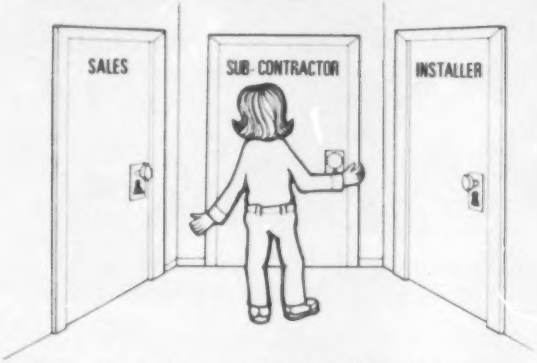
If you decide to go directly to work, you will need to ask yourself several questions. Where do I want to locate? What kind of company do I want to work for? What type of working conditions do I desire? As much as possible, know what you most want out of going to work. Use this information as a goal, and set your mind to achieving it.

Going Directly to Work

Jobs in the drywall industries are available to both high school graduates and non-graduates, the former having more potential for advancement.

Upon deciding to enter the job market and during the actual job search, a number of important factors should be kept in mind. First, you must evaluate your qualifications and decide what areas of employment are open to you. Secondly, you must locate the job opportunities; and thirdly, you must know how to actually acquire the job.

The completion of an extensive course in drywall application will qualify you to enter most phases of drywall installation. A less thorough course in drywall installation could qualify you as an applicator, nailer, taper or floater. Your knowledge, skills and background will determine the job you acquire.



Most students recently completing a training course in drywall application will find a good outlook for opportunities with an accomplished drywall installer. The employer in most cases will have only a few employees and will expect them to perform all phases of installation from repair to handling to finish. Opportunities for employment with the small contractor can be found in most towns or cities that show indication of growth in the building construction field. For more employment security in the drywall field, opportunities exist in prefabricating industries that require skills in specialized areas of installation. Duties may consist of application, securing by nails or screws or floating and finish work. These large prefabricating plants often offer training programs which allow opportunities for advancement.

When seeking a job in the drywall field, some of the most important areas in which to apply are: Directly to the small and large contractor; to the prefabricating plant; to an employment

counseling service; to the local or State employment commission. Once an interview has been arranged, be prepared to provide all information concerning personal data, past experiences and qualifications concerning the job for which you are applying. Remember that personal characteristics, education, skills, aptitudes and habits will be determining factors for acceptance.

More Education

In the field of construction, the drywall applicator is in an area of constant change. Manufacturers, architects and contractors are continually finding better, more economical and more rapid ways of utilizing gypsum products. Some types of construction now using gypsum were unheard of a decade ago.

Because change occurs so rapidly in drywall construction, on-the-job training with an independent contractor offers a good way to gain familiarity with the most modern materials and techniques while advancing the skills gained through a high school vocational program. There are usually ample opportunities for on-the-job training, providing a good high school vocational program in this area has been completed.

If you have the desire to further your education upon graduation from high school, there are a number of ways this may be accomplished. Sometimes education beyond high school in a specialized area of construction is difficult to obtain because of the limited number of institutions offering this kind of specialized training. However, in every State there are institutions offering a phase or complete course in drywall application. Schools with these offerings include community colleges, junior colleges, vocational-technical schools, local trade schools, area trade schools and private trade schools. An apprentice may be able to supplement his on-the-job training with classroom work, thereby fulfilling needed requirements of training by taking advantage of courses offered by the night school programs of these institutions. For current information concerning advanced training in drywall construction, you should visit your high school counselor.

GLOSSARY
DRYWALL

Angle cutting - a method by which a piece of wallboard is cut at an angle to its edges. Often used for the gable end of a structure.

Archways - a passageway under an arch.

Back-blocking - rectangular strips laminated by [illegible]tic behind joints that do not meet on a stud or furring.

Backing board - used in double layer application. The front and back faces are covered with a gray paper and are unexposed.

Baseboard - a board or molding covering a sidewall where it meets the floor.

Bedding - the application of joint compound over a joint prior to applying tape.

Bower stud - stud not in alignment with the other wall studs because of warping or twisting.

Building codes - rules and regulations determined by local and/or Federal authorities to ensure quality materials and workmanship.

Caulking - the application of a sealant to surfaces or crac[illegible] for waterproofing purposes.

Ceiling joist - 2 x 4 or 2 x 6 materials placed on edge on 16 inch centers and resting on top plates. Used as backing for furring of ceiling.

Clips [for sound absorption] - an attachment of wallboard to a furring in such a way that it is suspended away from the studding and joists.

Coreboard - gypsum board of 2 or 4 feet width and 1 inch thickness used as an inner core for solid gypsum walls.

Cripples - supports between top plates and door or window headers.

Cut-in brace - short cripples that begin beneath the top plates extending at a 45°angle to the top of the sole plate. The cripples are secured by nails to each stud.

Door trimmer - the flat surface on the inside of door openings which gives support to the door header.

Double layer - the use of two layers of wallboard on ceilings and sidewalls.

Finishing - a method of completing the surface of a joint.

Fire block - short pieces of blocking used as bracing and as a precaution against fire.

Floating - to apply joint compound and work it into a smooth finish with a trowel or wide putty knife.

Furring - secured wood or metal strips used as a backboard for cover materials.

Gypsum board - another name for wallboard.

Gypsum stud - factory laminated 1-5/8 x 6 inch studding for non-loadbearing walls.

Header - supports between top plates and door or window headers.

Horizontal application - installation of wallboard at a 90° angle to the studs or joists.

Insulation - a material installed in walls to retard the passage of heat, cold or sound.

Joint compounds - a mud-like compound used for tape bedding and joint finishing.

Laminate - securing two or more strips of material together by adhesives or fasteners.

Layout - marking or scribing the future location of partitions. Information is ordinarily acquired from architectural blueprints.

Let in brace - an exterior brace that extends from the top plates to the bottom or sole plate at a 45° angle and is cut in and nailed to each stud, creating a flush surface.

Nail pop - a nail that has been driven through gypsum board into studding or furring and has lost its holding power due to crushed wallboard.

Plumb - anything which is perfectly vertical.

Ridges - thin and high places on a joint caused by shrinkage of framing materials. This shrinkage compresses the joint causing the ridge.

Runners - "J" or "L" shaped metal used as support for core or backup of face panels.

Score - to make a light cut into the core of wallboard to prepare for snapping.

Scribe - a temporary mark made with a pencil or sharp object to indicate measurement.

Semi-solid partition - wallboard laminated to narrow panels and again laminated to narrow gypsum ribs. Used primarily for non-loadbearing walls.

Set nail - to countersink a nail by use of a nail set.

Shoe mold - a wooden strip shaped as quarter round and secured to baseboard as added protection for wallboard.

Single layer - use of one layer of wallboard.

Snapping - technique of breaking wallboard with a sudden motion after scoring.

Soffitts - the underside of a structural part of a beam or arch.

Sole plate - the 2 x 4 secured to a concrete slab or subfloor which is used as a base for studs.

Sound absorption - suppression or control of sound vibrations.

Soundboard - a sound-absorbent material that reduces sound and is used with wallboard (usually as a backboard).

Spotting nails - use of a flat tool to cover recessed nail spots with joint compound.

Square edges - the long, square, paper-wrapped edges of wallboard.

Steel stud - "U"-shaped angle metal used as a back-up for wallboard.

Straight bead - application of mastic or adhesive in a straight line.

Strongback - a 2 x 4 or 2 x 6 that runs at a 90° angle to a joist and helps pull bowed joists into place and support the roof.

Stud - the vertical 2 x 4 or 2 x 6 attached to sole and top plates for wall support.

Subfloor - the floor immediately below the finished floor.

Taping - a narrow strip of fibered paper embedded in joint compound which is used to cover wallboard joints.

Topping - the final process of applying joint compound.

Top plate - the bottom of the two 2 x 4 plates mounted on top of the studs, but beneath the ceiling joists.

Treating corners - the application of joint compound to one side of the corner at a time.

Trimming - cutting off rough edges of wallboard after it has been scored and snapped.

Triple layer - this method is the application of three layers of wallboard on each side of the wall. Some manufacturers consider this method to be solid wall construction.

Vertical application - wallboard installed parallel to the studs and joists.

V-grooved edges - edges shaped as a "V" for tight fitting. It is commonly used for exterior or solid partition construction.

Wallboard - another name for gypsum board.

Wire tying - a method of using wire to wrap and secure wallboard to columns.

Zig zag bead - a back and forth motion for applying adhesive or mastic.

APPENDIX
DRYWALL

California State Department of Education, *Drywall Construction Workbook*, (Bureau of Industrial Education: Sacramento, California), 1969.

Drywall Construction Handbook, (U.S. Gypsum Company: Department 122, 101 S. Wacker Drive, Chicago, Illinois 60606), sixth edition. Text edn.

FOR ADDITIONAL INFORMATION

Gypsum Association
201 North Wells Street
Chicago, Illinois 60606

Kaiser Gypsum Co., Inc.
300 Lakeside Drive
Oakland, California 94612

Mechanical Drywall of Canada, Ltd.
Hamilton, Ontario

National Gypsum Co.
Gold Bond Building
327 Delaware Avenue
Buffalo, New York 14202

Western Gypsum Products, Ltd.
Winnipeg, Manitoba

PAINTING AND WALLCOVERING

INTRODUCTION

Painters and paperhangers apply finishes to walls and other building surfaces. Painters and paperhangers belong to two separate building trades; however, many painters do paperhanging and *vice versa*. The painter applies coats of paint to the inside or outside walls of a building in order to decorate or protect them. The materials used may be varnishes, stains, enamels and lacquers. Paperhangers attach wallpaper, fabric, vinyl or other materials to inside walls of a building.

PREPARING SURFACES FOR PAINTING

Let us first look at how surfaces are prepared to receive paint. Surfaces are sanded with sandpaper or scraped smooth with steel wool. Sandpaper should be #1/0 or #2/0 quality. Fine steel wool is good for smoothing out rough spots on rounded or irregular surfaces. The steel wool used should be very fine—either 00 or 000 grade. If a surface is being repainted, paint remover is applied to remove the old coat. The undersurface is then sanded down.

After old paint has been removed and the surface has been sanded down, any defects in the surface are repaired. Cracks, nail holes and crevices are filled with caulking compound or putty. Caulking compound is applied with a caulking gun; putty is applied with a putty knife. The caulking gun is moved slowly along the surface so that the compound flows directly into the crack. The crevice is covered over entirely so that the compound can attach itself to the outer surface. The gun is held at a slight angle to the crack. Finally, the compound is tooled down with a putty knife or sandpaper until it is even with the surface.

Putty is squeezed into nail holes with a putty knife. The putty is cut off with the knife so that the surface is slightly dome shaped. Oil or grease spots on a surface are removed with a detergent.

Plaster surfaces must be at least 30 days old before they are painted with oil-based paints. Waterbase paints can be applied after 48 hours. Plaster should be sanded down smooth. Large cracks are filled with patching plaster; small holes are filled with spackle. *Spackle* is a powder which, when mixed with water, forms a paste. This paste then is applied to small cracks and holes in plaster. Patching plaster should dry for 24 hours; spackle should be dry in 4 hours. Finally, any grease or oil is washed off with a detergent and the wall allowed to dry.

MIXING PAINT

The painter then needs to know how to mix, or box, paint. Paint tends to settle while it is stored. Because of this it must be stirred and mixed thoroughly before it is applied. To mix paint the painter should take two gallon cans, one with paint and one empty. The thin liquid floating at the top is poured off. The settled paste is stirred thoroughly. Lumps are broken up by stirring the paste with paddles in a figure-8 motion. Meanwhile, the thin portion which has been poured off is poured back in. To complete the mixing process, the paint is poured back and forth between containers several times until the paint is of a uniform consistency.

BRUSH PAINTING

Painting with a brush is a familiar process. Certain tricks of the trade, however, will give a neater, more economical job. Dip the brush only about half its length to avoid build-up on the top of the bristles. The paint is laid on with short, vigorous strokes; then it is lightly cross-brushed with the tip of the brush to even it and eliminate brush strokes. The ceiling is painted first, then the walls and trim last. Corners and edges are painted so that the brush sweeps off the edge of the surface. The brush should not be poked into corners and edges; instead touch these rough places lightly with the edge of the brush and if necessary twist the brush slightly.

ROLLER PAINTING

Rollers are being used more and more for painting, especially since such a wide variety has become available for different jobs. Rollers are made up of a cylinder which is attached to and rotates around a metal bar which, in turn, is connected to a handle. Rollers range from 1-1/2 to 18 inches long and from 1/2 to 2-1/2 inches in diameter. The fabric used to cover the cylinder varies with the type of paint used; the length of the fuzz or "nap" varies with the texture of the surface. Lamb's wool works well with oil-based paints, since it becomes matted if used with waterbased paints. Nap lengths can range up to 1-1/2 inches with the longer naps most useful for very rough surfaces. Mohair, made from the hair of Angora goats, comes with nap lengths of 3/16 to 1/4 inch. It is especially good with enamels and on smooth surfaces. Two artificial fibers are used on rollers; dynel, which comes with nap lengths of 1/4 to 1-1/4 inches, is extremely good with latex paints; dacron, which is softer than dynel, is good with outdoor oil or water (latex) paints. Dacron comes in nap lengths ranging from 5/16 to 1/2 inch.

Rollers are easy to use. The paint tray is filled about half full of paint. Then the roller is dipped into the paint until it is completely covered. Excess paint is squeezed out by pushing the roller up the ramp of the tray. Screens which fit into five gallon cans of paint are also available to squeeze out excess paint. The first load of paint should be rolled out on a newspaper to remove any trapped air in the brush. The areas around the ceiling and the moldings are painted before the major parts of the surface are done. Trim work is usually done with a 3 inch wall brush. Painters roll from a dry area into an already painted area, using W-shaped strokes to begin. Then the roller is moved cross-ways to spread the paint, and finally vertically to smooth it. The roller should not be moved too fast, and it should not spit at the end of each stroke.

SPRAY PAINTING

Spray painting utilizes a pump and, usually, an electric motor to force paint through a nozzle and onto a surface to be painted. In the most common paint sprayer, paint is poured into a closed container called a pot. Compressed air forces the paint through a hose to a spray gun. A separate hose is connected to the spray gun. The paint is then atomized by air blown through an opening in the caps of the spray gun.

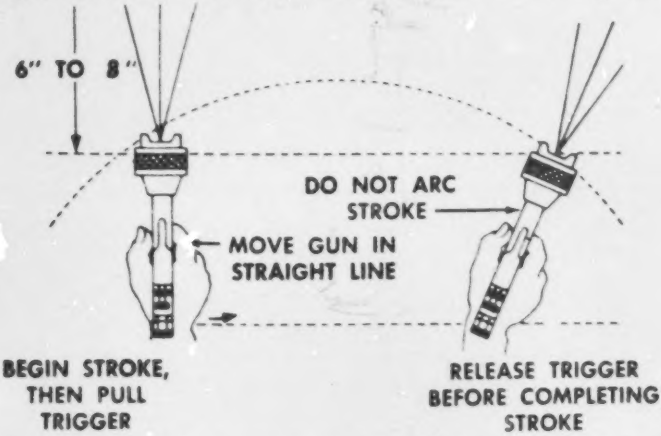
A second spraying process is called airless spray. Airless spray equipment utilizes a hydraulic pump rather than air pressure to force the paint. The pressures are much higher. Atomizing is done by forcing the paint through a fine strainer at pressures ranging from 1500 to 3000 pounds per square inch. Paint leaves the sprayer at a very high speed and the sudden release of pressure causes the paint to atomize. With this sort of equipment a more uniform paint job can be done.

There are several things to keep in mind when setting up and using spray equipment. The paint must be thin enough to be atomized and turned into a spray, but thick enough to stick to a surface without running or dripping. The air pressure on the pot of paint determines exactly how much paint will flow into the nozzle. If too e. If too much air is fed in, the paint will atomize too much and a fine dry spray will be produced. If too little pressure is applied the paint spatters and leaves a speckled, almost gritty, coat. The air cap on the spray gun controls the amount and distribution of air and how it mixes with the paint. The nozzle on the spray gun controls the amount of paint and air delivered to the surface. The paint's thickness should be changed only if necessary.

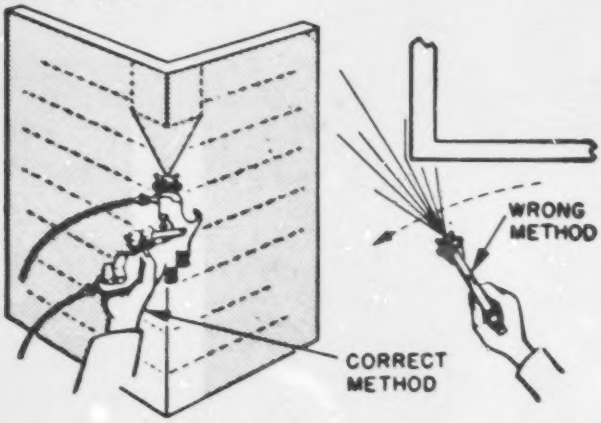
Paint pressure should be adjusted starting from the point where a stream of paint will shoot out 24 inches with the spray gun air

turned off. The exact pressure used in spray guns varies depending on the kind of paint used, the kind of nozzle used and the surface to be coated.

The spray gun should be held 6 to 10 inches away from the surface to be painted. If it is held much further away the spray will "*dust*," that is, the droplets will dry up in midair and hit the surface as hard, solid particles. The spray gun is kept at right angles to the surface to be covered. The gun is held straight and



not tilted. The painter's arm moves back and forth parallel to the surface. The spray pattern should feather. This can be done if the painter will pull the trigger on the gun after the stroke begins and release it before it ends. On corners, the paint stops 1 to 2 inches before the corner. Then the gun is swept up and down the corner so that both sides are hit.



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Once the job is finished, spray equipment must be cleaned carefully. This is done immediately after the paint job is finished and before paint can harden. Clean solvent is placed in the paint pot and run through the hoses and spray gun. This should be done two or three times until no paint is visible. Spray equipment operates under extremely high pressures. The pressure should be bled off before anything is opened.

WOOD CHARACTERISTICS

The most important thing to remember about wood is that it should be dry. Damp wood will not hold paint. Types of wood that are commonly painted are ash, birch or maple. Usually these woods are stained. Pine is used for framing and also indoors on baseboard, shoe mold and door jambs. Cedar and redwood are used for outdoor siding.

In general, the way in which the lumber is sawed will determine the grain and pattern of the wood produced. If the wood is very grainy it will absorb paint and probably have to be painted more frequently than a smoother wood. Knots in wood are the cross sections of branches, and they start deep inside the trunk of a tree. Pine knots usually bleed resin even through several coats of paint. Painters use knot sealers to stop bleeding before any paint is applied.

MASONRY CHARACTERISTICS

Masonry surfaces which are frequently painted are concrete, stucco and plaster. They have several things in common: They are hard, contain lime and are fairly porous. New masonry may be either rough or smooth. Smooth concrete in particular is often difficult to paint because the paint will flake and peel off. It will not stick to such a smooth surface.

Another problem with fresh mortar is that the lime makes it "alkaline." Alkalinic substances will turn oil-based paints into a greasy soap-like substance which will not stay on a wall.

Still another problem which occurs with masonry surfaces is called *efflorescence*. Concrete, stucco and plaster all contain salts which dissolve in water. If water soaks through the masonry it will dissolve these salts and they will crystallize on the surface of the masonry. If the paint is water soluble, these salts will soak through the paint and crystallize on the surface, creating unsightly spots. If the paint is not soluble, these crystals will form beneath the surface of the paint and create blisters. Either way, efflorescence has to be washed away and its cause removed before a masonry surface can be painted.

Differences in quality may occur in different spots in the masonry. If the plaster, stucco or cement was mixed, applied or cured improperly, different parts of the surface may absorb different amounts of paint. This means that a coat of paint will be glossier on some parts of the wall than on others. This sort of surface will cause paint to flake easily and results in a poor quality paint job.

KINDS OF PAINT AND LACQUERS

A painter needs to know the kinds of paints and lacquers which will be used. In the last twenty years latex paints have become fairly popular. In latex paints, pigments are suspended in little oil droplets called *colloids* which, in turn, are suspended in water. When the water evaporates, a film of pigment is left on the surface. Latex paints are almost odorless, easy to apply and dry rapidly. They are also nonflammable. Because latex films are porous, they do not blister from accumulations of moisture beneath the film. One problem with this type of paint, though, is that it does not cling to dirty or chalky surfaces easily. Still, they last for a very long time if properly applied, and they can be applied at any temperature above freezing. They dry very quickly, and, once the paint is dry, the surface can be washed. Latex paint is thinned with water.

Oil-based paints, which are thinned with turpentine, or mineral spirits are the oldest paints in use. They are used mostly on outside wood and metal surfaces because they dry too slowly to be used indoors. Oil-based paints form a rough, durable film on the surface and can be washed easily. These paints should not be applied at temperatures below 50°, though, because cold makes the oil too thick to flow easily. Oil paints come both with solid pigments and with stains. Stains are pigments which are dissolved at a low density in linseed oil. This means that there is little coloring material contained in a relatively large amount of oil. Stains penetrate wood surfaces easily and thoroughly. Large amounts of stain are brushed onto the wood surfaces and allowed to dry. Then the excess is wiped off, and that portion of the stain which has penetrated the wood remains.

Enamels are fast drying and, when dry, have a hard, smooth, glossy finish. They are used on woodwork because they are washable. Both waterbased and oil-based enamels are on the market.

Varnish is simply paint without pigment. It is transparent or translucent liquid that permits the surface coats to be seen. It is made by heating a mixture of tough resinous materials (usually synthetic resins) and a drying oil such as linseed or tung oil. The high temperature melts the resin and mixes it with the oil, and

when this mixture is cooled, it becomes very thick and heavy. Solvents such as petroleum spirits are added to make the varnish ready to apply, and a drier is added to speed the drying of the oil.

Lacquer, like varnish and shellac, is transparent. It contains four basic ingredients: Nitrocellulose or gun cotton, which makes it fast drying, tough and hard; resin, which gives it adhesion and gloss; plasticizer, which gives it flexibility; and lacquer thinner, which dissolves the first three ingredients and gives the mixture proper application properties. To convert this clear lacquer into a colored lacquer, pigments like those used in paint are added. Clear lacquer functions as a varnish; pigmented lacquer functions as a paint. The most unusual feature about lacquer is the speed with which it dries. As soon as the lacquer thinner has evaporated, a perfectly dry and hard film is left. The evaporation may take as little as five minutes. Lacquer produces a very hard, glossy finish and is widely used on furniture and decorative objects. It is usually sprayed on objects because, when brushed on, it is extremely difficult to avoid brush marks.

Included in the varnish and lacquer family is *shellac*. Shellac is a gummy secretion from small insects that attach themselves to certain trees which grow mainly in India. The insects, known as "lac bugs," deposit the secretion on the tree branches. It is removed, washed, cleaned, melted and hardened to form what is known as "orange shellac." When this is bleached, it is called "white shellac." The shellac is then dissolved in alcohol. When the solution has been applied to a surface, the alcohol evaporates into the air, and the dry, hard shellac is left as a transparent finish. Speed of drying is one of the main reasons shellac is popular for use on floors and furniture. It is also easier to sand than regular varnish. When it is used as a first coat on hardwood floors, followed by an application of wax, an attractive finish results. Shellac scratches much more easily than regular varnish, however, and it is also less resistant to water, alcohol, soap and detergent solutions. As a result of these properties, shellac is usually used on surfaces that will not be washed often and which are not subject to hard wear.

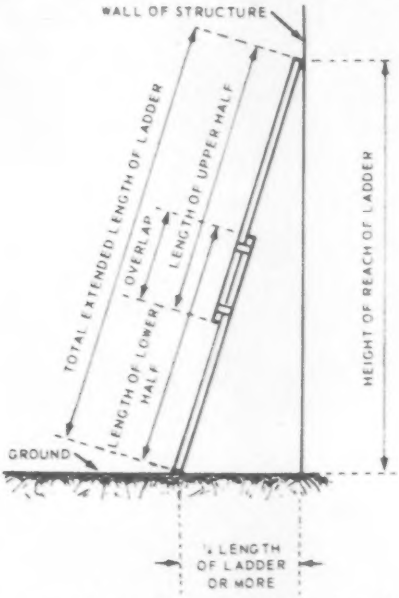
STAINS AND PRIMERS

In addition to the above mentioned materials, there are stains and primers or undercoatings. Stains are becoming more popular in modern building. They are used to change the color in various types of wood and to bring out the beauty of the grain. They now come in latex, as well as oil base form. Primers are used to prepare a surface to be painted with finish coats. Enamel undercoating is a must when applying enamel paint to new surfaces.

SAFETY CONSIDERATIONS

In any painting job there are hazards which are special to painting. Because painters work from scaffolds or from ladders, falls are a possibility. A knowledge of safety procedures on scaffolds and ladders is essential. There are several basic things to remember. Scaffolds should be put together by experienced workers. Blocks under scaffold legs should be wide enough that the scaffolding does not slip off. The parts of the scaffold should be plumbed and leveled as the scaffold is being built. Guard rails should be set up around the planks. The planks should be thick enough and strong enough to support the weight they will carry. Planks ought to overlap each other by 12 inches and extend beyond the supports by 6 inches. Ladders should not be placed on top of scaffolds.

Ladders should be checked before use. They should be set so that the distance from the lower end of the ladder to the wall is one-fourth the length of the ladder. Both legs of the ladder should



rest on solid ground. Ladders should not be placed in doorways. Painters should not lean out over either edge of the ladder. Hand lines should be used to raise or lower materials from the ladder.

Also there are fire hazards. Painters often use very flammable materials. Most paints are flammable and so are most of the materials used to clean painting tools or to thin paints. Further,

painters often work indoors where there is relatively poor ventilation. Paint fumes are frequently explosive and in an unventilated area can build up to dangerous levels.

A third danger which painters face is the health hazard. Cleaning compounds and solvents, acid and alkali cleansers are usually irritating to the skin and corrosive. They are particularly dangerous if they get into eyes. Also, paint fumes can be extremely poisonous if they are inhaled.

ADDITIONAL FACTORS IN APPLYING PAINT

Another factor to consider in painting is weather. Low temperatures (that is temperatures below 50°) cause oil-based paints to thicken and makes them difficult to apply. Paints dry slowly at low temperatures. High temperatures sometimes cause paint to be too thin and dry too rapidly. Paint applied in very hot weather often shows brush marks clearly. Humidity and frost slow down drying and often cause paint to blister and peel off.

Paint, as it ages, deteriorates. There are several ways in which deterioration occurs. Paint may soil. Dirt will accumulate on the painted surface and stick to it. After a certain amount of dirt has been picked up, the surface becomes discolored and ugly. Soiling is particularly noticeable with light colored paints and with sticky, oil-based paints.

Color changes are another problem with old paints. Bright colors in particular will fade and become dull after a time. Light colors will become even lighter. White paints in areas unlighted by sunlight will become yellow. This is especially true of oil-based white paint.

Two other major sorts of deterioration occur in paint. The first of these is called *chalking*; the second is called *checking and cracking*. Chalking results from the weathering of the paint surface. The dry paint vehicle breaks down and leaves behind a dry, fine powder which can be rubbed off with the finger. Chalking takes place more rapidly in those places exposed to large amounts of sunlight. Checking and cracking are breaks in the surface of the paint film which occur as the paint becomes hard and brittle. As the paint film heats and cools, the paint film expands and contracts. After the paint has aged it loses its ability to expand or contract easily. It then begins to crack and flake off. Checking is the beginning of this. Checks are tiny cracks which appear in the upper part of the paint.

In humid climates mildew grows on paint. At first mildew looks like dirt but cannot be washed off easily. Spots on painted surfaces can be checked by applying household bleach to them.

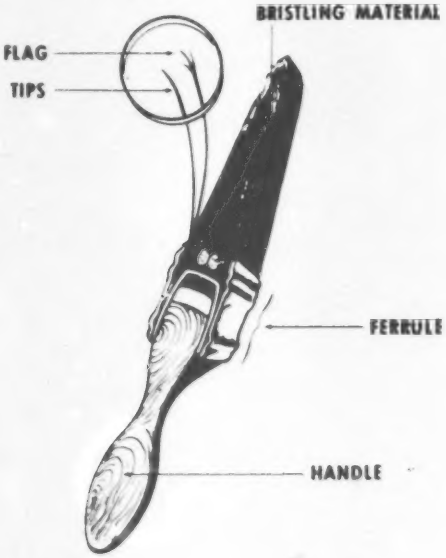
Mildew bleaches, while household dirt does not. Mildew, if left untreated, will eventually destroy a paint job. Enamels and paints containing zinc oxide are more resistant to mildew than others. In very moist places, specially made mildew-resistant and moisture resistant paints should be used.

PREPARING SURFACES FOR WALLPAPER

Paperhangers, or wall coverers, have a somewhat different task. The first step in papering a wall is to prepare the surface. On a plaster or masonry surface, the paperhanger applies "*sizing*." This is a coating which makes the plaster less porous and so helps the paper to stick to the masonry surface. On some jobs the paperhanger may have to do minor plastering work in order to get a smooth surface. On old walls, the paperhanger must sometimes remove old layers of wallpaper. This is done by soaking it with water or steaming it. Once the surface is ready to receive the wallpaper, it should be carefully measured. Then the paperhanger cuts a length from the paper and positions the patterns so they match at the ceiling and baseboard. Paste is then applied to the reverse side of the paper. Finally the paste covered paper is placed on the wall and is smoothed into place by hand and with a dry brush. Air bubbles are brushed out by smoothing the paper, starting at the center and pressing toward the outer edge. If it is patterned paper, the paperhanger then matches the adjacent edges and cuts and smooths the edges at the ceiling and base. Seams are smoothed between strips with a roller. Finally the strip is checked for wrinkles or air bubbles.

TOOLS AND EQUIPMENT

The three basic tools that a painter must master are the brush, roller and spray gun. There are many different types of brushes to fit specific needs. When selecting a modern paint brush, you will need to be familiar with basic brush terminology.



Brushes

Angular edge – the flag end of the brush is longer at one side than the other to form an angle on the end of the brush. This is useful where working up to an edge is required.

Butt ends – the end of the bristles which are embedded into the ferrule.

Chisel edge – an edge which resembles a carpenter s chisel and provides an even paint application.

Ferrule – the material which covers the ends of the bristles. It is usually made of aluminum and holds the bristles to the handle of the brush.

Flag ends – these are the painting ends of the bristles. Each bristle consists of several fine hairs which are important in that they determine the amount of paint the brush can store before it is applied to the surface (after it is dipped in the paint).

Heel – the heel is the section of the brush that goes into the ferrule.

Solidarity—a good brush should contain a great many more long bristles than short ones. The more long bristles, the greater the solidarity of any given brush.

Square edge—large brushes usually have even edges and maintain their natural bend toward the center.

Taper—the bristles are thicker at the butt than at the flag end. This is achieved by proper blending of the different lengths of bristles, thus making the brush more useful.

Texture—texture is the proper consistency of stiff and soft bristles in the brush.

There are also numerous types of brushes available in different sizes and with different edges for specific jobs.

Artists' brushes are small and designed for fine work. A variety of edges and lengths are available.

Calcimine brushes are used to apply whitewash and are usually 5 to 8 inches long with extra long bristles.

Dusting brushes are used to free surfaces of dust and dirt. They come in several shapes and sizes. They are usually inexpensive, but are very important.

Enamel and varnish brushes come in both flat and chisel edges, and are usually from 2 to 4 inches wide and 3 to 4 inches long.

Roof brushes are generally attached to a long handle and are used to apply paint to large shingle areas.

Stippling brushes resemble the traditional scrubbing brush, are 3 by 9 inches and are made without the usual brush handle.

Stucco and masonry brushes are made of fiber or nylon bristles to withstand tough wear. They are usually 5 to 6 inches wide with 4 to 6 inch long bristles.

Wall brushes are used to apply paint or stain to wall surfaces, both interior and exterior. Widths vary from 3 to 6 inches. The bristles are from 2 to 7 inches long and usually 3/4 to 1-1/2 inches thick. They usually have flat ends. Trim and sash brushes are divided into three groups—flat trim and sash brushes for narrow boards, oval trim and sash brushes for narrow boards and angular cut sash brushes for hard to reach surfaces. These brushes are from 1 to 3-1/2 inches wide and are from 1 to 5 inches long.

Wire brushes are used for preparation of surfaces and are available in a variety of sizes and shapes.

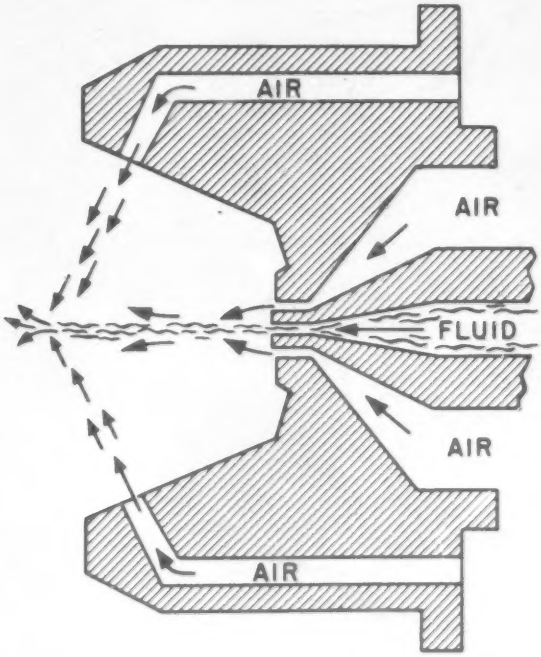
Cleaning Brushes

A good rule to follow in cleaning a brush is to clean it with the solvent you used to thin the paint. In other words, oil-base paints,

enamels and varnishes generally require turpentine or mineral spirits. Shellacs should be removed with alcohol. Waterbase paints, such as latex, acrylic and calcimine paints, should be removed with soap and water. Soak the brush for a few minutes in the appropriate solvent and then squeeze solvent through the brush until it is clean and free of paint.

Sprayers

A relatively new painting tool is the paint sprayer, or "spray gun" as it is often called. There are two types of paint sprayers on the market today. One type uses a compressed air supply and the other type is an airless spraying unit. The compressed air method uses air at a pressure of 30 to 45 pounds per square inch which either flows over a suction pipe or takes up paint from a cup. The air/paint mixture then passes through a nozzle and is shaped into the desired round or flat jet.



A variation on the paint sprayer is the "aerosol paint package". This consists of a small can in which paint has been packaged under pressure. The top has a small valve which, when depressed, permits the paint to sprav from the can.

Airless spraying units are electrically powered, high-pressure appliances. An eccentric bearing, mounted on the motor shaft, drives the reciprocating hydraulic piston. At each piston stroke oil is thrown in a pulsating flow onto a diaphragm of high tensile strength to withstand the reciprocating motion. The oscillating diaphragm draws up paint on the side opposite the hydraulic fluid and drives it under high pressure out of the gun.

There are many types of spray guns, tips and protective masks on the market today. Follow the manufacturer's suggestions for proper use of this equipment.

Rollers

For painting interior walls, the paint roller has become very popular. This is simply a hollow roller covered with a suitable fabric and set on an axle attached to a handle. It literally rolls paint onto the wall. Rollers are divided into three basic groups—dip type, fountain type and pressure type. The dip type roller is dipped into a metal container in order to gather paint on the roller. Paint iss poured inside the fountain type roller so that the roller becomes its own paint supply. Paint is fed into the pressure roller by compressed air, creating a constant supply to the roller without dipping.

Paint rollers come in widths ranging from one inch to eighteen inches. The most common size is nine inches. You can find a roller for almost any particular job, including a special segmented roller made for painting metal pipes and sponge rollers for corner work. Paint rollers can be usd with almost any kind of paint, but are mostly used with latex base paints. Most of the clean up is done with soap and water.

Other Painting Tools

Other painting tools include electric sanders, blow torches, putty knives, wood scrapers, caulking guns, hammers, pliers, chisels, screwdrivers, electric drills, paint mixer or paddles, paint mixing tubs, paint strainers, stripping tools, glazing knives, brush holders, sandpaper, dry wall tape, float knives and pan and steel wool. To aid in reaching elevated areas, step ladders, extension ladders, sky hooks, lean-to scaffolds, bracket scaffolds and outrigger scaffolds, chicken ladders and ladder hooks are used.

Wallpapering Tools

Basic tools for wallpapering are a smoothing brush, plumb line and chalk, shears, seam roller, sponge and bowl, wheel knife or razor blade cutter, wallpaper paste, paste bucket and brush, yardstick, patching plaster, wall scraper, sandpaper and straight-edge.

AFTER GRADUATION

Toward the end of your senior year you will need to make a decision as to whether you want to seek additional training in painting and wallcovering or go directly to work. Even though you probably have a fairly accurate assessment of your capabilities, it would be wise to discuss your next move with your instructor or counselor.

If you decide to go directly to work, you will need to ask yourself several questions. Where do I want to locate? What kind of company do I want to work for? What type of working conditions do I desire? As much as possible, know what you most want out of going to work. Use this information as a goal, and set your mind to achieving it.

Many painters and wallcoverers work for contractors engaged in new construction. Substantial numbers of painters and wallcoverers also are employed by contractors to do repair, alteration or modernization work on existing structures. Hotels, office buildings, shipyards, utility companies, manufacturing firms, schools, government units and other organizations that own or manage extensive property holdings commonly employ maintenance painters. When interior redecorating involves wall papering, as in hotels or apartment buildings, maintenance painters also may do the required paperhanging.

The work of painters and wallcoverers often requires standing for long periods of time, climbing and bending. A painter must have strong arms because much of the work is done with arms raised overhead. Painters and wallcoverers risk injury from slips or falls from ladders and scaffolds.

A large proportion of painters and wallcoverers are members of the International Brotherhood of Painters and Allied Trades. A few of them are members of other unions.

Painters and wallcoverers may advance to supervisory positions. They also may advance to jobs as estimators for painting and decorating contractors—computing material requirements and labor costs. Some may become superintendents on large contract painting jobs, or they may establish their own businesses as painting and decorating contractors.

More Education

Most training authorities, including the National Joint (labor-management) Painting and Decorating Apprenticeship and Training Committee recommend the completion of a 3-year formal apprenticeship as the best way to become a journeyman painter or wallcoverer. A substantial proportion of painters and wall-

coverers, however, have learned the trade informally, working as helpers to experienced personnel or by observing or being taught by them. Workers without formal apprentice training have gained acceptance as journeymen more easily in these crafts than in most of the other building trades.

Apprentice applicants generally are required to be between 16 and 25 and in good physical condition. A high school education is preferred, although not essential. Applicants should have manual dexterity and a discerning color sense. They should not be allergic to paint fumes or to the other materials used in these trades, such as varnish, turpentine and lacquer.

The apprenticeship for painters and wallcoverers generally consists of 6,000 hours (3 years) of on-the-job training, in addition to 144 hours a year of related classroom instruction. Many apprenticeships combine painting and wallcovering. In a typical 3-year training program, the apprentice learns, among other things, to use, care for and handle safely the tools, machines, equipment and materials commonly used in the trade. Also learned are how to prepare surfaces (including sizing, sandpapering and patching walls); matching and mixing colors; and applying various types of interior and exterior materials (including stain, lacquer, enamel, oil and varnish). Instruction is given on how to erect scaffolding.

In addition, the apprentice receives related classroom instruction in such diverse subjects as color harmony; paint chemistry; estimating costs; and making, mixing and matching paints. Also

learned is the relationship between painting and wallcovering and the work performed by the other building trades craftspeople.

Hourly wage rates for apprentices usually start at 50 percent of the journeyman rate and increase periodically until the journeyman rate of pay is reached upon completion of apprenticeship.

GLOSSARY

PAINTING AND WALLCOVERING

Abrasive—an agent used in abrasive blast cleaning; for example, sand, grit, steel shot, etc.

Acetone—a fast-evaporating, highly flammable solvent.

Acoustic paint—paint which absorbs or deadens sound.

Acrylic resin—a clear resin derived from polymerized esters of acrylic acid and methacrylic acid.

Adhesion—bonding strength; the attraction of a coating to the surface to which it is applied.

Air bubble—a bubble in paint film caused by entrapped air.

Air entrapment—inclusion of air bubbles in paint film.

Airless spraying—spraying which uses hydraulic pressure to atomize the paint.

Alcohol—a flammable solvent; alcohols commonly used in painting are ethyl alcohol (ethanol) and methyl alcohol (methanol, wood alcohol).

Alkali—a caustic such as sodium hydroxide, lye, etc.

Alkyd resins—resins prepared from polyhydic alcohols and polybasic acids.

Ambient temperature—room temperature or temperature of surroundings.

American gallon—23 cubic inches.

Amides—curing agent combined with epoxy resins.

Arcing—swinging spray gun away from the work.

Asphalt—residue from petroleum refining; also a natural complex hydrocarbon.

Atomize—to break a stream into small particles.

Baking finish—a product requiring heat curing.

Banding—identifying with strips of tape.

Binder—resin; drying oil; latex emulsion; film former; vehicle.

Bituminous coating—coal tar or asphalt based coating.

Bleaching—removing color.

Bleeding—penetration of color from the underlying surface.

Blisters—bubbles in dry or partially-dry paint film.

Blushing—whitening and loss of gloss due to moisture or improper solvent balance.

Body—viscosity; middle or under coat; to thicken.

Bubbling—a term used to describe the appearance of blisters on the surface while a coating is being applied.

Caking—hard settling of pigment from paint.

Catalyst—accelerator; curing agent; promoter.

Cat-eye—hole or holiday shaped like a cat's eye; cratering.

Chalking—powdering of surface.

Checking—formation of slight breaks in the film that do not penetrate to the underlying surface.

Cleaner—detergent, alkali, acid or other cleaning material or solvent used for cleaning paint equipment.

Coal tar pitch—black residue remaining after coal tar is distilled.

Coal tar-epoxy paint—paint in which the binder or vehicle is a combination of coal tar with epoxy resins.

Coatings—surface coverings; paints; barriers.

Coat of paint—layer of dry paint resulting from a single wet application.

Cohesion—property of holding or bonding together.

Cold checking—checking caused by low temperatures.

Cold-cracking—cracking occurring at low temperatures.

Color-fast—non fading.

Color retention—ability to retain original color.

Cracking—splitting; disintegration of paint by breaks through film to the substrate.

Crawling—shrinking of paint to form an uneven surface shortly after application.

Cross-spray—spraying first in one direction and then at right angles.

Curing—setting up, hardening.

Curtains—sags having the appearance of drapes.

Decorative painting—painting primarily for appearance.

Delamination—separation of layers of paint films.

Density—weight per unit volume.

Dew point—temperature at which moisture condenses.

Doctor blade—a knife applicator of fixed film thickness.

Drier—chemical which promotes drying of paint.

Drop (scaffold)—one vertical descent of the scaffold.

Drop cloth—protective cover.

Drying time—time interval between application and a specified condition of dryness.

Dry to recoat—time interval between application and ability to receive next coat satisfactorily.

Dry to touch—time interval between application and ability to be touched lightly.

Edging—stripping.

Eggshell—between semi-gloss and flat.

Elasticity—degree of recovery from stretching.

Emulsion paint—water-thinned paint with an emulsified oil and/or resin or latex vehicle.

Enamel—a paint which is characterized by the ability to form an especially smooth film.

Epoxy ester—epoxy modified oil; single package epoxy.

Epoxy resins—film formers usually made from bisphenol A and epichlorohydrin.

Etch—surface preparation of metal by chemical means.

Fading—reduction in brightness of color.

Fanning (spray gun technique)—arcing; moving the spray gun away from the work.

Feather edge—tapered edge.

Feathering—triggering a gun at the end of each stroke; tapering edge.

Ferrous—iron containing.

Field painting—painting at the job site.

Filler—extender; bulking agent; inert pigment.

Film build—dry thickness characteristics per coat.

Film former—a substance which forms a skin or membrane when dried from a liquid state.

Film integrity—degree of continuity of film.

Film thickness—depth of applied coating; expressed in mils (1/1000 in.).

Film thickness gauge—device for measuring film thickness; both wet and dry are available.

Filter—strainer, purifier.

Fingers (airless spray)—broken airless spray pattern.

Fire-retardant paint—a paint which will delay flaming or overheating of surface.

Flaking—breaking into small pieces or flakes; scaling.

Flammability—measure of ease of catching fire; ability to burn.

Flash point—the lowest temperature at which a given material will flash if a flame or spark is present.

Flatting—loss of gloss in coating film.

Forced drying—speeding drying by increasing the temperature above the ambient temperature using an oven, infrared lamp, or other heat source.

Fungicide—a substance which is poisonous to fungi; prevents fungi growth.

Furane resins—dark chemical-resistant resins made from furfuryl alcohol, furfural and phenol.

Gel—a jelly-like substance.

Glazing—setting glass.

Gloss—shininess, ability to reflect in mirror direction.

Grain—surface appearance, mainly of wood.

Guide coat—a coat similar to the finish coat, but of a different color to help obtain complete coverage.

Hardener—curing agent; promoter.

Hazing—clouding.

Holiday—pinhole, skip, void.

Hot spray—spraying material heated to reduce viscosity.

Humidity—measure of moisture content in air.

Hydraulic spraying—spraying by hydraulic pressure.

Internal mix—a spray gun in which the fluid and air are combined before they leave the gun.

Iron phosphate coating—conversion coating; chemical deposit.

Isocyanate resins—urethane resins.

Ketones—flammable organic solvents such as acetone.

Lacquers—coatings which dry by evaporation of the solvent.

Laitance—milky-white deposit on new concrete.

Latex—rubber-like; a common binder for emulsion paints.

Leafing—orientation of pigment flakes in horizontal planes.

Leveling—flowing out to films of uniform thickness.

Maintenance painting—repair painting—painting after the initial paint job.

Mandrel test—a physical bending test for adhesion and flexibility.

Masking—covering areas not to be painted.

Mildew—fungus, mold.

Mineral spirits—aliphatic hydrocarbon solvent.

Miscible—capable of mixing or blending uniformly.

Misses—skips, voids.

Mist-coat—thin coat.

Mottling—speckling.

Mud-cracking—irregular cracking of dried film.

Naphtha—flammable hydrocarbon solvent.

Neoprent—rubber-like film former based on the polymerization of chloroprene.

Non-volatile—solid-non-evaporating, the portion of a paint left after the solvent evaporates.

Opacity—hiding power.

Orange peel—surface resembling an orange peel.

Orifice—opening; hole.

Overcoat—top coat.

Overlap—width of fresh paint covered by next layer.

Overspray—sprayed paint which did not reach the target.

Pass—motion of the spray gun in one direction.

Pattern length—length of spray pattern.

Pattern width—width of a spray pattern.

Peeling—paint curls or strips from surface.

Pickling—a dipping process for cleaning steel and other metals.

Pigments—solid coloring agents.

Pitting—small shallow depressions or cavities.

Pin-holing—formation of small holes through the entire thickness of coating.

Pock marks—pits, craters.

Pole gun—spray gun equipped with an extension.

Polyvinyl acetate—synthetic resins used extensively in water paints.

Pot-life—time interval after mixing of reactive components during which liquid material is usable with no difficulty.

Prime coat—first coat.

Primer—material used for first coat.

Protective life—interval of time during which a paint system protects a surface from deterioration.

Recoat time—time between coats.

Red label—flammable or explosive materials with flash points below 80° Fahrenheit.

Resin—a material contained in varnishes, lacquers and paints, film former.

Respirator—safety breathing mask.

Rust—corroded iron.

Sandblast—blast cleaning using sand as an abrasive.

Scale—rust occurring in thin layers.

Scaler—hand cleaning chisel.

Seal coating—coating used to prevent absorption of the first coat.

Sealer—a low-viscosity liquid sometimes applied to wood.

Settling—caking, sediment.

Shade—degree of color in a tint.

Shelf-life—maximum time a material may be stored and still be in usable condition.

Shop coat—coating applied in a fabricating shop.

Short oil varnish—a varnish prepared by cooking a relatively small quantity of oil with 100 pounds of resin; quick drying, brittle.

Silicate paints—those employing silicates as binders.

Skips—misses, uncoated area.

Slow drying—requiring 24 hours or longer before recoating.

Spalling—the cracking or splintering of materials.

Spar varnish—a varnish for exterior surfaces.

Specular gloss—mirror-like reflectance.

Stroke—a single pass with a spray gun in one direction.

Substrate—basic surface.

Surface conditioner—preparatory coating applied to chalked, painted masonry surface for bonding chalk to under-surface.

Surface preparation—all operations necessary to prepare a surface to receive a coating of paint.

Surfacer—a paint used to smooth the surface before finish coats are applied.

Sweating—condensing moisture on a surface.

Tack—degree of stickiness.

Tails (airless spray)—finger-like spray pattern.

Tank white—good hiding, self-cleaning white paint used for exterior metal surfaces.

Thinners—volatile organic liquids used for reducing viscosity; solvents.

Tie coat—intermediate coat used to bond different types of paint coats.

Tint—a color produced by mixing white paint or pigment in a greater amount with a non-white colored paint or pigment.

Tooth—profile, surface roughness.

Top coating—final coat.

Touch-up painting—spot repair painting, usually done after initial painting.

Toxic—poisonous.

Unit cost—cost per given area.

Urethane resins—a particular group of film formers, such as isocyanate resins.

Useful life—the length of time a coating is expected to last.

Varnish—liquid composition of oil, resin thinners and driers which convert to a transparent film after application as a coating.

Vehicle—liquid carrier, binder.

Vinyl coating—one in which the major portion of the binder is a vinyl resin.

Vinyl resins—synthetic resins made from vinyl compounds such as vinyl acetate.

Viscosity—a measure of fluidity.

Volatiles—fluids which evaporate rapidly.

Washing—erosion of a paint film after rapid chalking.

Wash primer—a thin rust-inhibiting paint which provides improved adhesion to subsequent coats.

Water blasting—blast cleaning using high velocity water.

Wet edge—fluid boundary.

Wet film thickness—thickness of liquid film immediately after application.

Wire brush—a hand-cleaning tool comprised of bundles of wires.

Yellowing—development of yellow color in white paints upon aging.

APPENDIX

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ADDITIONAL SOURCES OF INFORMATION

Painting and Decorating Contractors Association of America
2625 West Peterson Avenue
Chicago, Illinois 60645.

International Brotherhood of Painters and Allied Trades
1925 K Street, N.W.
Washington, D.C. 20006.

Frank R. Pitts, Secretary
National Spray Painting and Finishing Equipment Association
300 Phillips Avenue
Toledo, Ohio 43601.

Robert W. Matlack, Executive Secretary
Federation of Societies for Paint Technology
121 South Broad Street
Philadelphia, Pennsylvania 19107.

GLASS AND GLAZING

INTRODUCTION

Glaziers cut, fit and install plate glass, ordinary window glass, mirrors and special items such as leaded glass panels. They usually specialize in one of these areas. For instance, some glaziers specialize in installing mirrors, some specialize in installing windows in residences, and other specialize in installing glass room dividers and shower curtains. There are glaziers who specialize in installing auto glass (special safety glass) in automobiles and there are glaziers who specialize in "hanging" storefronts and other large sheets of plate glass in urban buildings. Still other glaziers specialize in cutting or polishing glass in a shop.

A rapid increase in employment of construction glaziers is expected through the 1970's. Replacement and modernization work, frequently involving large glass installations, also will contribute to the demand for these workers. The long-range outlook for this occupation generally can be considered very favorable.

HOW GLASS IS MADE

Glass is made from sand, lime and soda. When sand and soda are melted together and cooled, they produce a hard, glassy, transparent substance called *sodium silicate*. If lime is added to sodium silicate, a durable glass is made. The addition of other materials will vary the properties of glass. Each type of glass has specific characteristics and is used in specific ways.

TYPES OF GLASS

The most common types of glass are window glass, heavy sheet glass and plate glass. *Window glass* and *heavy sheet glass* are available in several thicknesses, but the most common thicknesses found in construction are single strength and double strength glass. Single strength glass is usually about .10 inches thick and is used to glaze areas of less than 400 square inches. Double strength glass is about .133 inches thick and is used where high wind resistance is needed. The clearness of the glass determines its grade: (AA) is superior, (A) is very good and (B) is the general grade. Heavy sheet glass comes in 3/16, 7/32 and 1/4 inch thicknesses. It is sold in sheets which range up to 76 x 120 inches. Although heavy sheet glass is sometimes used in windows, it is usually used in greenhouses. Because it is slightly wavy, it distorts the view.

Plate glass is used in very large windows and doors. It is made from a continuous molten ribbon which is cut into sheets. Once a

sheet hardens, both sides are ground and polished to make it very clear. It is sold in thicknesses which range from 1/8 to 1-1/4 inches.

Though window glass, heavy sheet glass and plate glass are the most common kinds of glass, there are other types of sheet glass on the market for special purposes. Several kinds of glass are used for insulation. *Heat-absorbing glass* is a heavy sheet glass. It is either 1/8 or 1/4 inch thick, colored light blue or light green. This glass absorbs the sun's infra red waves and blocks out more than 35 percent of the heat. Other insulating glass is made up of two or more sheets of glass separated by an air space that can be 3/16, 1/4 or 1/2 inch thick. Insulating glass units are sealed at atmospheric pressure. Some units are made up of window glass, others of polished plate glass. There are also units which have sheets of heat absorbing, laminated, patterned or tempered glass. Some types of insulating glass have a heated air space. In these units the inner surfaces of the glass panes are coated with a thin layer of a metallic oxide. This coating has a very high resistance to the flow of electrical current, so that heat is created when electricity flows through it. This kind of insulating glass is often installed in large commercial buildings such as hospitals, restaurants and computer centers where a close control of temperature is necessary.

Coated or tinted glass also insulates against heat. It is coated with an extremely thin layer of metallic oxide or some other coloring compound which reduces the amount of light passing through the window. The reduction of light reduces the heat. In hot climates, buildings will often have tinted windows, as well as air conditioning. The use of tinted glass can cut air conditioning costs a great deal.

In addition to glass which controls heat, there is also *sound-insulating glass*, or "acoustical insulating glass". Acoustical insulating glass is similar to heat insulating glass in that both have two panes of glass separated by an air space. However, acoustical glass has a wider air space — about two inches — than heat insulating glass, which has, at most, a 1/2 inch air space. The inner pane is often thicker than the outer pane. A unit with a 1/4 inch outer pane will often have a 3/8 inch inner pane. The sides of acoustical insulating units are lined with insulation to further reduce sound.

There are several kinds of *high strength glass*. All high strength glass must be cut to precise size, with proper holes drilled, before strengthening. High strength glass is useful in many places where ordinary glass would break, such as school windows and plate glass windows in frequently vandalized neighborhoods. One ad-

vantage of high strength glass is that it does not shatter into jagged pieces when it breaks; it crumbles into many tiny fragments.

One high strength glass is called *"tempered glass"*. Tempered glass is glass which has been reheated to just below its melting point and then suddenly cooled by being dipped into an oil bath. Once it has been tempered, it cannot be cut or drilled. Therefore, it must be ordered to exact size. Although it will hold up to heavy impacts and great pressures, it will shatter into small pieces if it is tapped near one of its edges. Another glass is called *"heat-strengthened glass"*. It is made of polished plate glass or patterned glass that is reheated and cooled. Heat-strengthened glass is used in curtain walls in large buildings. Another strengthened glass is *wire glass*. Wire glass is a flat glass sheet which contains a hexagonal or diamond-shaped welded wire mesh embedded in the center of the sheet. The glass surface may have patterns or figures on it, or it may be polished. The wire in the center gives the glass added strength. Still another high strength glass is *laminated glass*. Laminated glass is made up of one or more sheets of glass with one or more sheets of laminated plastic vinyl sandwiched between the glass. An adhesive holds the glass and vinyl together in a single unit. The plastic membrane cushions blows and prevents sharp pieces of glass from flying. Laminated glare-reducing glass has a pigment in the vinyl sheet which cuts light transmission.

Acrylic plastic, a strong glass like substance, is often used where both lightness and strength are needed. For instance, it may be used in shower enclosures in bath rooms where broken glass would be very dangerous. Skylights often are made of acrylic, because it can stand up under heavy hail or snow pressure. When acrylic breaks, it does not shatter as does glass. Acrylic sheets are less than half as heavy as glass. They are flexible and they can be *cold formed*. This means that they may be bent to a smooth contour and then sprung into place. By using curved channel supports they can be held in the curve. Acrylic does have certain disadvantages. It expands and contracts more than glass. When large sheets are used, it tends to sag under its own weight. This can be countered by using rigid pre-formed acrylic sheets.

WHAT A GLAZIER DOES

Let us look at some of the things glaziers do. Glass is cut with either a diamond cutter or a wheel cutter. The diamond cutter holds a sharp commercial diamond which is pressed down and pushed along the glass to cut it. Diamond cutters are seldom used because they are expensive and hard to work. The wheel cutter

has a steel handle with a small, sharp, steel wheel in its head. As the glazier presses down on the cutter, he slides it along the glass surface, cutting a narrow groove into the glass. Cutting wheels usually are 7/32 inch in diameter. Wheel cutters should be stored in a mixture of 1/2 kerosene and 1/2 light oil. This will keep the cutter clean, prevent rust and lubricate the wheel.

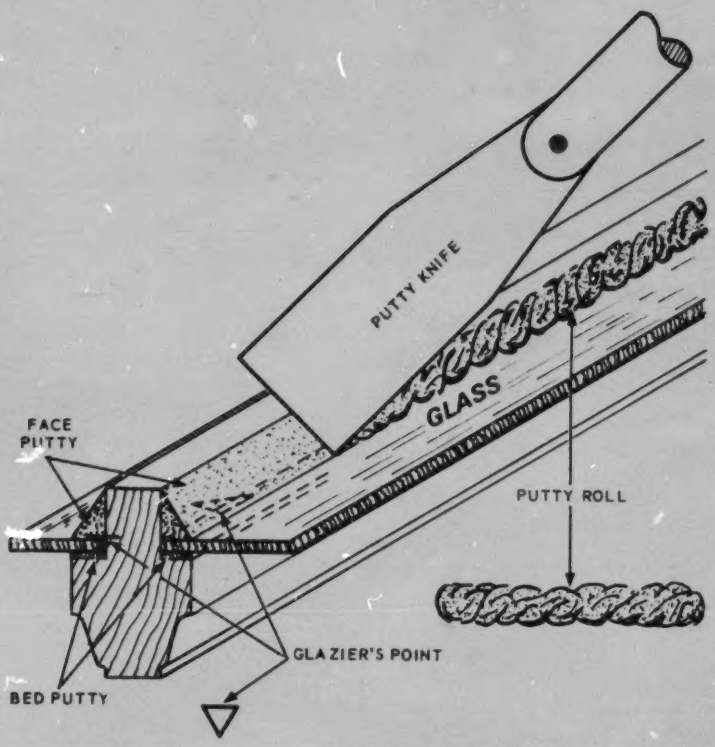
Cutting Glass

Glass to be cut is first brushed off with a clean cloth. It is then laid out on a flat table on top of layers of newspaper. Kerosene is brushed onto the glass along the line to be cut. The wheel of the glass cutter is oiled with sewing machine oil. A straightedge is laid carefully along the line to be cut. The glass cutter is held between the glazier's first and second fingers, pointed straight up and down at right angles to the glass. Beginning 1/8 inch from the farthest edge of the glass, the cutter is run along the straightedge on a firm, even, continuous hair-line. Then the glazier grasps the glass firmly on both sides of the cut. He gives the glass a quick bending motion to break it. Any uneven edges are nipped away with glass pliers. This is a tool which has two long, flat faces for breaking off narrow strips of glass and for nibbling away uneven edges after a cut.

Installing Glass

The method of installing glass in a window depends on whether the sash is new or old and whether it is wood or metal. A new window sash must be cleaned and a coat of primer paint applied. Once the primer dries, the window is ready to be glazed. If the sash is old, all the oil, dirt, old putty, glazing points and glass fragments must be removed. In either case, the exact length and width are measured with a glazing rule or tape measure. There should be a tolerance of 1/16 to 1/8 inch when these measurements are laid out on the pane. Then the pane is cut to size.

There are two ways to glaze a wooden window. One method is called *face glazing*; the other is called *stop glazing*. In face glazing, the pane is held by the wooden back rim of the sash on one side and a wedge-shaped strip of putty on the other side. The glazier first applies a continuous ribbon of bedding compound to the *rabbet*, which is the wooden bed and rim of the sash on which the glass is supported. Then the pane is pressed into position with equal pressure on all four edges. In front of the pane at least four glazier's points are installed — one at each corner. *Glazier's points* are thin zinc tacks used to hold panes in place. They are installed with a glazier's hammer, because ordinary hammers are difficult



to work with so close to glass. When the points are in, a putty strip is pressed into place all around the pane. The putty is smoothed out with a putty knife so that it forms a smooth, shaped fillet 1/16 inch below the line of sight. Once again, bedding is applied with a bedding gun. Then the glass is pressed carefully into place with even pressure on all four sides. The glazier applies a front bed of putty and smooths it with a putty knife. Then rounded wooded stops are placed in the rabbet and attached with small nails using an eight or ten ounce hammer.

If the window has a metal sash, the pane is attached in a different way. In some metal sashes the pane is held in place with metal clips. To install the pane, the clips are snapped out without kinking the sash or the clips. Any fragments of broken glass are taken out with tweezers. Old sealant is scraped off with a cloth and razor blades. Then silicone rubber or polysulfide caulking is applied evenly around the sash with a brush or small wooden paddle. Excess sealant is trimmed away and the pane pressed into

place. The clips are snapped back in. The pane is cleaned of excess sealant with a razor blade.

Many metal sashes have screw-on moldings. These moldings are removed with a Phillips screwdriver. Once the moldings are removed the procedure is the same as before. Any glass fragments are removed with tweezers. Old sealant is scrd off with a cloth or a razor blade. Silicone rubber or polysulfide is brushed on with a wooden paddle or small brush. The pane is pressed into place and the moldings replaced.

One sort of metal window frame uses wrap-around rubber or vinyl gaskets to hold the pane in place. Usually, the gasket is held in place by a screw-on metal frame. This frame is unscrewed, and the gasket is removed. Fragments of broken glass are picked out with tweezers. The new pane is pressed into place. Finally the gasket, the frame and the screws are all replaced.

Installing Mirrors

Glaziers also install mirrors. One of the simplest ways to install a mirror is to put up an unframed mirror with mastic. *Mastic* is a very thick, sticky, putty-like substance used as an adhesive. The first step in hanging the mirror is to paint the back with a water-resistant paint. Using screws, nails or toggle bolts, a channel support as long as the mirror bottom is attached to the wall. About one-third of the back of the mirror is covered with mastic, using a putty knife or wooden paddle. The last step is simply to press the mirror into place, making sure the mirror rests evenly in the channel.

Mirrors can also be hung with double-faced tape. First make sure that the backing of the mirror will not deteriorate in contact with the tape. The tape is about 1/8 inch thick and supports one pound for each 1/2 square inch of tape. After the tape has been selected, the mirror is weighed. Then the glazier calculates the amount of tape which will be needed to support the mirror. The bottom edge of the mirror is measured and a channel or clips installed. The glazier cuts the exact number of strips of tape needed to support the mirror. The tape is stuck on vertically, and the top ends are trimmed to a point so that moisture can drain away. Finally the mirror is pressed into place; the bottom is carefully fitted into the channel.

Screws or rosettes are frequently used to attach mirrors to walls. Holes are drilled in the mirror before it arrives on the construction site. The holes should be 1/8 inch larger in diameter than the screw diameter. If the mirror is less than 10 square feet it will require only four screws, one at each corner. The screws are

placed about 4 inches from the mirror edge. On plaster walls toggle bolts are installed to support the mirror, and screws are inserted into the bolts. With mirrors larger than 10 square feet, screws are spaced about 36 inches apart on centers. A felt or rubber washer is placed between the mirror and the screwhead. The screw itself should not be excessively tightened.

Mirrors can also be attached to wooden backing. This is often done on masonry walls. The first step is to measure the length and width of the mirror. Then pieces of 3/4 by 1-3/4 inch board are cut the length of the mirror. The wooden framing is attached to the wall with countersunk screws or toggle bolts. The face and edges of the wood are painted to match the surrounding wali surface. Finally wooden or plastic clips are fastened with screws to the lower edge of the wooden panel and 4 inches below the top edge of the mirror on the sides. Felt cushions are placed between the clips and the mirror face, and the mirror is slipped into place.

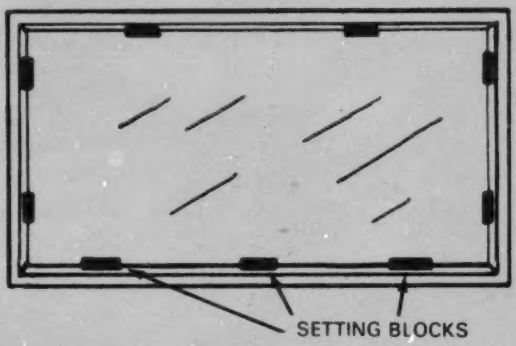
A mirror can also be hung by using a channel along the bottom to support it and clips along the top to keep it in place. A metal or wooden channel is cut the length of the bottom edge and mounted with screws or toggle bolts. Clips are placed halfway up the side of the mirror and at the top. The bottom edge of the mirror is painted to protect it from moisture which may accumulate in the channel. The mirror is placed in position and felt pads are placed between the clips and the mirror.

Installing Plate Glass Windows

Glaziers also do a great deal of work with plate glass, installing plate glass windows and doors in storefronts and large commercial buildings. All methods of installation begin with the careful measurement of the window frame. The measurements taken are compared to the measurements indicated on the blueprints. Any rivets, bolts, screwheads and so on in the rabbets are nailed down or removed. Finally, a coat of primer paint is applied to the glazing channel.

The two most common ways of installing plate glass in storefronts, rely on gaskets: One method uses a neoprene gasket; the other uses a zipper gasket. When a neoprene gasket is installed, the glazing channel is first measured. Then the necessary length of gasket material is cut. The gasket material is then fitted into the glazing channel, beginning in the upper left hand corner and working counter-clockwise. Once the gasket is fitted into place, the plate glass is lifted up with two or more vacuum cups and set vertically into one of the glazing channels as

far as it will go. Then the glazier swings the glass around so that it clears the opposite edge of the channel. Neoprene setting blocks are set beneath the plate. The blocks are placed one-quarter of the length of the bottom edge of the glass away from the edges



or "at quarters". The glass is rested on the blocks. After the vacuum cups are removed, the inner seal of the gasket is placed around the glazing frame, once more beginning in the upper left hand corner and working counter-clockwise.

Zipper gaskets have been developed fairly recently to hold plate glass. Using zipper gaskets, the glass slips right into place. First the frame is measured. Gasket material is measured off and cut. It is then placed in the glazing frame. Vacuum cups are used to lift the glass. The glass is placed in the gasket. Then a zipper tool is used to lay a thick strip of rubber inside the glazing channel. This zipped-in rubber strip holds the glass in place.

Installing Plate Glass Doors

Glaziers also install plate glass doors. Glass doors are installed in much the same way as plate glass windows. The outer gasket is installed over the outer rim of the glazing channel. Two hard rubber or neoprene blocks are placed 6 to 8 inches away from the upper outer corner of the door, one in the vertical channel, the other in the horizontal channel. Two more neoprene blocks are placed 6 to 8 inches away from the lower inner corner, one in the vertical channel and the other in the horizontal channel. Vacuum cups are used to lift the glass into the frame. The glass is slipped first into one vertical channel and then the other. Then the glass is set down in the bottom channel. After the vacuum cups are removed, the inner gasket seal is installed flush with the line of sight.

Installing Acrylic Plastic Sheets

Glaziers frequently install acrylic plastic sheets in windows, storefronts, skylights and many other places. Small acrylic sheets are easy to install in wooden sashes. The rabbet is measured. Then, given the length and width of the rabbet, the manufacturer's recommendation on correct size of pane should be checked. Acrylic sheets expand and contract with heat and cold, and the sheet must be cut to allow for this. With a putty knife, a bed of nonhardening glazing compound is formed. Then the pane is centered in the bed and fastened with glazing points. Finally, face sealant is applied to the face with a putty knife. The face should slope to form a wedge shaped fillet.

When acrylic sheets are installed in storefronts, the glazier must remember that acrylic expands and contracts with heat more than does glass. Also it bends under pressure more than glass. When storefronts are installed, the rabbet is measured. Then manufacturer's recommendations are checked to find the proper length, width and thickness to allow for expansion and contraction. Any obstacles in the rabbet must be taken out — burrs, screwheads, bolts, etc. Wood and steel in the sash are painted; aluminum is cleaned with solvents. Neoprene setting blocks are set at quarters in the bottom of the glazing channel. On the inner edge of the sash, butyl tape or a 1/4 inch wide strip of silicone or polysulfide sealant is set. If silicone or polysulfide sealant is set, a strip of non-oily filler tape is also set. The acrylic sheet must be covered with masking tape except at the edges. The edges of the sheet are covered with naphtha. The sheet is centered in the sash. The back of the sash is fastened back. Excess masking tape and glazing compound are removed. Finally, the acrylic is cleaned with a soft rag dipped in naphtha, kerosene or unleaded gasoline.

Edging And Beveling Glass

Glaziers bevel and edge glass to remove rough raw edges which could easily cut a person. Edging and beveling can be done either with a grinding machine or by hand with a silicon-carbide stone or cloth. There are a variety of types of beveling and degrees of edging. The three common degrees of edging are ground smooth and polished. A coarse abrasive is used on a natural cut to give a ground edge which looks white. A fine abrasive used on a ground edge gives a smooth edge, which is opaque. A polished edge is produced by rubbing a fine range abrasive over a smooth edge. This leaves a clear glass edge. A ground edge can be produced without difficulty, using a portable sander. The glass is placed on a table, with the edge to be ground overhanging the table by about 1/4 inch. The glazier must wear goggles or a safety mask. A

number 60 (coarse) grit silicon-carbide belt is used. The sander is moved back and forth so that the entire belt surface is used. The sander must be lifted away from the glass from time to time so that it does not overheat. Chips and fragments are washed away after the job is finished.

Hand edging techniques are fairly simple. The glass is placed on a table so that the edge to be worked overhangs slightly. The glazier takes a #49 sharpening stone and dips it into a water-kerosene mixture. The stone is rubbed with a circular motion along the edge of the glass, dipping the stone often. Hand-edging with a silicon-carbide cloth is similar to using grinding stones. The cloth is tacked to a wooden block. The glass is placed so the edge overhangs the table. The cloth is rubbed over the edge, using a circular motion. Then the edge is finished with a rouge cloth. When the edge is finished, chips and fragments are washed off.

SUMMARY

These are the main tasks done by glaziers. Of course, each job will be slightly different, and each of the tasks described here has many different variations, but the work described includes most of the usual glazing processes.

TOOLS AND EQUIPMENT

Glaziers work with both standard hand tools and specialized glazing tools. Some of the more commonly used tools and equipment are listed below.

Bevelers—Bevelers are usually electrical belt sanders with an emory or silicon carbide-impregnated belt attachment. They are used to smooth and polish the cut edges of glass.

Bevel square—The bevel square is a two-bladed instrument which can be set to any desired angle. To use it, you adjust the blades to the desired angle, hold one blade to one surface and check whether the other blade fits along the other surface.

Chalkline—Chalklines are used to snap long straight lines on a surface. They consist of cotton or rayon yarn saturated in chalk dust and wound on a reel.

Combination square—A combination square is a square made of an adjustable ruler and an attachment machined to hold a 90° angle on one side and a 45° angle on the other.

Glass cutters—Two types of glass cutters are commonly used:

- Wheel cutters—Wheel cutters consist of a 1/4, 7/32 or 1/8 inch steel wheel mounted on a steel or wooden shaft. They

should be stored immersed in a mixture of kerosene and light oil.

- Diamond glass cutters—Diamond glass cutters have a hard commercial diamond embedded in the head. They are expensive and somewhat hard to control.

Glass pliers—Glass pliers have a broad, flat mouth and are used to break off narrow strips of glass or unwanted, jagged pieces remaining after a cut.

Putty knives—The broad, flat blades of putty knives are generally made of steel and often have a 45° miter in one corner. They are used to spread and smooth putty or glazing compound.

Razor blade holder—A razor blade holder is a device with a handle which allows glaziers to slide a razor blade over glass to remove paint, putty or other adhesives.

Tin snips—Tin snips are heavy-bladed steel scissors used for cutting light metal and nipping uneven fragments off glass.

Vacuum cups—Vacuum cups are rubber suction cups which are attached to heavy pieces of plate glass which are to be lifted. They have a small pump attached to them for pumping out air and a valve which allows air to enter, thereby breaking the vacuum. They also have handles to help carry the glass.

Zipper tool—This is a tool somewhat like a large screwdriver with a hole in it. It is used to wedge the zipper into place to lock a neoprene zipper gasket.

SAFETY CONSIDERATIONS

Different hazards and safety precautions are involved in different phases of glass working. All precautions are related to three basic facts about glass: It easily breaks into sharp, jagged fragments; sheets of glass can be extremely dangerous when they fall; glass can be heated to very high temperature without a change in texture or other outward appearance to indicate the heat—thereby creating a considerable potential for burns.

Alertness and common sense are probably the most important safety precautions. By exercising these and the following recommendations, there is no reason why working with glass should not be as safe as any occupation.

- Keep your work area cleared of unnecessary material. Make sure your work table and storage space has a smooth, even surface, and keep it free of dust and glass chips.
- Never press bare skin against raw edges of glass (edges which have been cut or broken and not polished). Carry

small sheets of raw-edged glass at the top with the thumb and first finger grasping the sides of the glass. Carry heavy sheets of raw-edged glass at the bottom, using a rubber-palmed glove or a rubber hand grip (a 7 x 7 x 1/8 inch rubber pad) laid over the raw edge.

- Be careful with broken glass! Wear gloves when you pick it up. Pick up the large pieces first, then use tweezers to pick up the smaller pieces. Do not feel around for other glass fragments with bare hands; you may find them in a very painful way.
- Be careful with heated glass. Glass can be heated to a very high temperature and yet retain its usual appearance. The only way you can tell that it has been fired is by touching it—and getting burned. Use spatulas or asbestos, or even work gloves, when inspecting glass which has been fired or heated.
- Wear goggles when polishing or beveling glass, and a safety shield attached to a hard hat when fabricating metal—especially when cutting with a radial saw.
- It is imperative that you wear a hard hat in the warehouse and on the construction site, and it is recommended that you wear hard-toed shoes. Safety sleeves with metal finglets, a leather apron, safety leather cuffs and rubber gloves are also highly recommended for warehouse work.

- Ladders are useful, necessary equipment on many jobs, but they are also a source of many accidents. Ladders should basically be used for moving from one level to another. If it is absolutely necessary to work from a ladder or move anything by means of a ladder, extra precautions should be taken.
- You should make every attempt to familiarize yourself with the dangers inherent in each of the power tools you work with. Avoid using power tools while standing on a wet surface, and take care to insure that all electrical equipment is properly grounded.

AFTER GRADUATION

Toward the end of your senior year you will need to make a decision as to whether you want to seek additional training in glazing or go directly to work. Even though you probably have a fairly accurate assessment of your capabilities, it would be wise to discuss your next move with your instructor or counselor.

If you decide to go directly to work, you will need to ask yourself several questions. Where do I want to locate? What kind of company do I want to work for? What type of working conditions do I desire? As much as possible, know what you most want out of going to work. Use this information as a goal, and set your mind to achieving it.

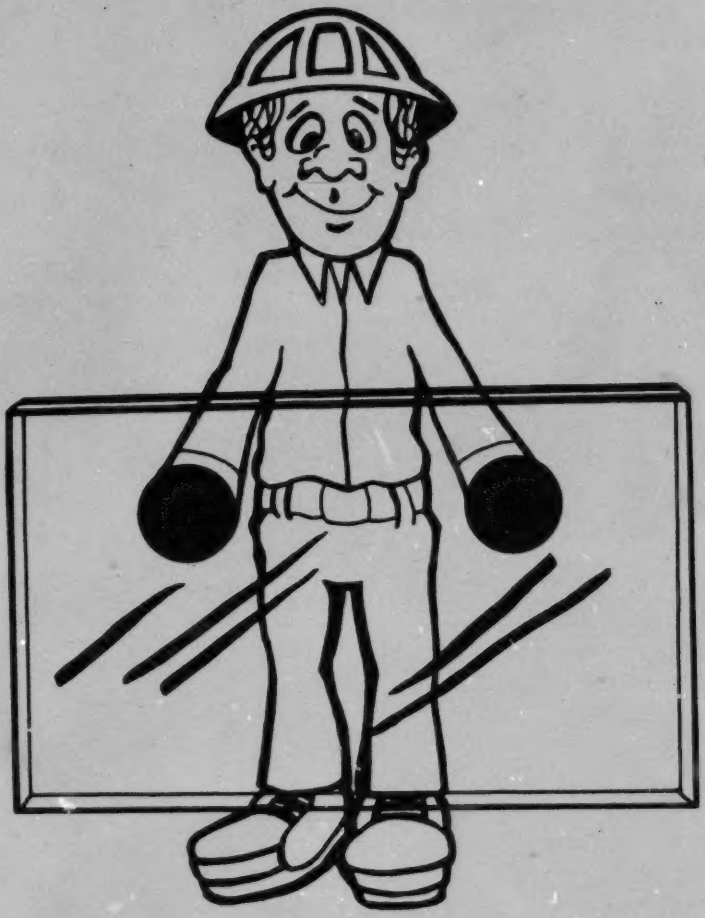
Going Directly To Work

Most of the estimated 10,500 construction glaziers employed in 1970 worked for glazing contractors engaged in new construction, alteration and modernization work and on the replacement of broken glass, particularly for store windows. Some glaziers were employed by government agencies or business establishments which do their own construction work.

About 12,500 glaziers work outside the construction industry. Many are employed in factories where they install glass in sash, doors, mirror frames and partitions. Others, using skills similar to those used by glaziers, install glass or mirrors in furniture and ships or replace glass in automobiles.

A large proportion of glaziers employed in construction work are members of the International Brotherhood of Painters and Allied Trades.

To go directly to work in glazing, you should have the physical ability to carry plates of glass and to climb, reach, stretch and perform other movements necessary for aligning and installing glass and mirrors. You must generally be able to work quickly at a



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steady pace, but with great care to avoid breaking glass. As you gain experience you must learn to judge how much tension, pressure, stress and strain different types, sizes and thicknesses of glass can withstand without breaking.

Glaziers generally work a 40-hour week with double time pay for emergency calls and time and a half for regular overtime. Work may be either indoors or outdoors, and employment may be affected by business booms or recessions. Fringe benefits generally include hospitalization, profit sharing plans, paid vacations, social security and paid sick leave.

More Education

Most training authorities, including the National Joint (labor-management) Glazier and Glassworker Apprenticeship Committee, recommend the completion of a 3-year apprenticeship program as the best way to learn the skills of the construction glazier. A substantial proportion of glaziers, however, have learned the trade informally. They have acquired their skills by working with experienced glaziers and observing or being taught by them. In smaller communities, many journeymen painters and paperhangers also have learned to do glazier work as part of the apprentice training for their trade.

Apprenticeship applicants generally are required to be at least 18 years of age, but they should not have reached their 26th birthday. Eligible veterans are exempt from the maximum age limit. A high school diploma or its equivalent is required.

The apprenticeship program usually consists of 6,000 hours (3 years) of on-the-job training, in addition to a minimum of 144 hours a year of related classroom instruction. During the apprenticeship, the trainee learns how to use and handle the tools, machines and materials of the trade. Instruction is given in safety measures and first aid, and the reading of specifications and blueprints and scaffolding. The program includes on-the-job training in the glazing of wood and metal sash in doors, windows, partitions and other openings; the setting and replacement of all types of store front installations, structural glass, mirrors, showcases, partitions and fixtures and automobile glass.

Hourly wage rates for glazier apprentices usually start at 50 percent of the journeyman rate and increase periodically until the journeyman rate is reached at the completion of training.

GLOSSARY
GLASS AND GLAZING

Back putty—the putty applied to the rabbet which holds the glass in place and keeps it attached to the rabbet.

Back-up—back-up is material set in a joint in order to control the depth of the sealant.

Bars—long, thin strips of wood or metal which generally run parallel to one another and divide up the light, the space to be glazed. Horizontal bars are often called "muntins" (see "muntin").

Bead—any sealing material or compound applied to a joint; also, any molding or panel used to hold glass in position.

Bed or bedding—the layer of putty applied to the rabbet into which the glass pane is laid or "set."

Bedding of stop—the glazing compound or putty set at the base of the channel just before the stop is set in place. Also the compound may be buttered on the face of the stop.

Bevel of compound bead—a bead which has a top surface slanting away from the glass panel so that water will drain.

Bite—the overlap between the stop and the glass pane.

Block—a small layer of neoprene or butyl rubber set under a plate glass window. Generally two such blocks are set 1/4 of the length of the glass away from either side. The weight of the glass rests on the blocks and not on the metal sash.

Buttering—buttering is the application of putty or glazing compound with a putty knife to a flat surface of the sash.

Channel—a U-shaped, three-sided support under a window or mirror which is usually made of metal and which has a [illegible] spot running down the center from side to side to allow water to drain. Usually channels have a removable stop.

Channel depth—the distance from the channel bottom to the top of the stop.

Channel glazing—channel glazing is the use of channeled supports in setting mirrors and windows.

Channel width—the distance between the fixed and removable stops.

Clips—thin metal wires which are attached to a metal sash and hold the pane in place in rabbets are called clips. Face glazing is applied over the clips.

Compound—an elastic, adhesive, easily-molded material which is used to attach glass panes to wooden or metal sashes.

Compression—the pressure applied to a compound in a joint.

Concave bead—a bead with a concave surface.

Consistency—the softness or firmness of a compound.

Convex bead—a bead with a convex surface.

Curing agent—a chemical which will cause a base compound to set.

Durometer—a measurement of hardness, as in neoprene or rubber.

Elastomer—any elastic or rubbery substance.

Exterior glazed—glass set from outside a building.

Exterior stop—a removable molding which holds the glass in place and is located outside a window.

Face glazing—the exterior triangular bead applied to the pane after setting it in the rabbet and applying clips or glazing points.

Face lock—the exterior piece of metal holding plate glass windows in place.

Gasket—a band or layer of neoprene or butyl rubber which is applied to metal sash before glazing. It is placed between the metal and the glass as a cushion to shocks and heat expansion.

Glazing—glazing is the practice of cutting, polishing and setting glass in windows, doors, mirrors, room dividers, etc. Glaziers often assemble the metal window or door frames which hold the glass, as well.

Gun consistency—compound with a consistency suitable for application by means of a caulking gun.

Heel bead—the compound applied in a channel after the pane is set and before the removable stop is installed.

Interior stop—removable molding placed on the inner-side of a pane.

Knife consistency—compound with a consistency suitable for application with a putty knife.

Light—the empty space, bounded by the sash, which the glazier fills with glass.

Mastic—heavy-consistency compounds which remain elastic even with age.

Muntins—muntins are short bars, usually thin and made of wood, which are used to divide a light into a number of smaller lights.

Non-drying—any compound which does not form a surface skin.

Points—thin pieces of zinc used to hold glass in place in wooden sashes.

Priming—the sealing of porous surfaces with paint.

Rabbet—an L-shaped space in a sash into which glass is fitted.

Sash—the frame, either metal or wood, on which glass is mounted.

Sealant—the compound used to seal a joint.

Setting—the process of mounting glass in a sash.

Shore hardness—the scale of hardness measurement used on a durometer.

Sight line—an imaginary line around the perimeter of the pane which corresponds to the top of the stop.

Size of bead—the width, and sometimes width and depth, of a bead.

Spacers—small blocks placed in a channel to center the pane.

Stop—the front molding which holds the pane in place.

Striking off—the removal, and smoothing away of excess glazing compound.

Vinyl glazing—the use of a vinyl channel to hold glass in place.

Work life—the time in which a sealant remains workable after being mixed with a setting compound.

APPENDIX
GLASS AND GLAZING

Rudman, Jack, *Civil Service Examination Passbook: Glazier*, (National Learning Corporation: 20 DuPont Street, Plainview, New York 11803).

ADDITIONAL SOURCES OF INFORMATION

Architectural Glass Products
PPG Industries
Architectural and Construction Services
1 Gateway Center
Pittsburgh, Pennsylvania 15222

Facing Tile Institute
c/o Smith, Bucklin and Associates
111 E. Wacker Drive
Chicago, Illinois 60601

Flat Glass Marketing Association (publishes *The Glazing Manual*)
1325 Topeka Avenue
Topeka, Kansas 66612

International Brotherhood of Painters and Allied Trades
United Nations Building
1750 New York Ave. N.W.
Washington, D.C. 20006

National Glass Dealers Association
1000 Connecticut Avenue, Suite 505
Washington, D.C. 20036

United Glass and Ceramic Workers of North America
556 E. Town Street
Columbus, Ohio 43215

Window Glass Cutters League of America
1146 Barnet Rd.
Columbus, Ohio 43227

FLOOR COVERING

INTRODUCTION

Floor covering installers (also called floor covering mechanics and floor layers) install, replace and repair a number of floor coverings. This manual will examine the materials and operations of two general groups of floor coverers: Those who install resilient floor coverings and those who install carpeting.

The tools used by floor covering installers include hammers, pry bars, knives, shears and other cutting devices; measuring and marking tools, such as tape measures, compasses, straightedges, scribes, chalk and chalklines; and a variety of specialized tools such as notched adhesive trowels, carpet stretching devices and floor rollers.

Employment of floor covering installers - estimated at about 40,000 in 1970 - is expected to increase rapidly through the 1970's. The projected increase in employment of floor covering installers is expected mainly because of the anticipated expansion in construction activity. Moreover, the use of resilient floor coverings and wall-to-wall carpeting will become more widespread. More versatile materials and colorful patterns are expected to contribute to a growing demand for floor coverings. For example, epoxy materials, a relatively new floor covering, is extremely durable and can be used in many ways—as a solid floor covering to be painted a variety of colors, or as an adhesive or base for laying resilient flooring. The best job opportunities will be for floor installers having all-around training in the installation of resilient tile or carpeting.

RESILIENT FLOORING MATERIALS

Let us first look at the materials used in resilient flooring. Resilient flooring comes either in sheets or tiles. Sheet flooring may be either sheet vinyl or linoleum. Sheet vinyl is made by bonding vinyl plastic onto a burlap backing. Sheet vinyl can stand up to grease, acids, alkalis and petroleum products. Sheet vinyl is smooth and flexible. It comes in a wide range of colors and patterns. Rolls of sheet vinyl are sold that offer a variety of widths. Linoleum is made by heating linseed oil until it becomes thick and gummy. Powdered cork, resin and pigments are mixed in with the linseed oil, and the material is laid out on burlap and pressed into sheets. Linoleum is sold both in plain and patterned rolls.

Vinyl tile is sheet vinyl which has been cut into blocks. The most common sizes are 6 x 6 inches, 6 x 9 inches, 9 x 9 inches and 12 x

12 inches. Both sheet vinyl and vinyl tile are available either in solid colors or in a wide variety of patterns.

Asphalt tile is made from asbestos fibers which are bound together in asphalt. The mixture then is pressed into sheets 1/8 or 3/16 inches thick and cut into tiles 9 x 9 inches, 12 x 12 inches or 18 x 24 inches. A wide range of colors and designs are sold. Asphalt tile is the most inexpensive kind of resilient flooring material.

OPERATIONS USED – RESILIENT FLOOR COVERING

Now we will examine some of the operations used in resilient floor covering. Before anything else is done, the subfloor must be inspected and the area must be checked. Electrical facilities must be available. The areas must be well-ventilated. The fumes from the adhesive used on resilient floors are very strong, and floor installers need a lot of fresh air while they use this adhesive. If the floor is being installed in cold weather climate, a heater will be needed. A temperature of at least 70°F needs to be maintained from 48 hours before the floor is to be laid until 48 hours after the job is completed. If the subflooring is made of wood, loose boards are nailed down and damaged boards replaced. Old finishes are removed; rough or high spots are sanded down. Any cracks, holes or other damaged areas wider than 1/8 inch are repaired with plastic wood. The floor must be checked to be sure that it has at least an 18 inch clearance beneath so that moisture will not accumulate.

Concrete Slab Preparation

If the subflooring is a concrete slab, it must be even, dry, smooth and uncracked. Anything covering the surface, such as old varnish, paint, adhesives and dirt, must be removed. If the concrete is chalky, it is swept and a coat of sizing applied. Cracks and expansion joints are filled with a latex filler or floor patch compound. Rough concrete is ground smooth with clean, wet sand and a terrazzo grinder. Mastic is applied over floors which cannot be smoothed. Finally, the slab is swept and vacuumed.

Concrete slabs must be checked for moisture content to see if the floor is too damp to receive resilient tile. For this, the floor installer takes a relative humidity indicator and places it on the floor next to a wall or pillar. The indicator is covered with an 18 inch square of polyethylene, which is fastened to the floor with friction tape. If the slab is 4 inches thick or less, the indicator is left on the floor for 24 hours. If the slab is thicker than 4 inches the test should run for at least 72 hours. The indicator must be held at a constant temperature as long as the test is being run, so it is insulated with

sheets of burlap, fiberglass or some other good insulating material. If the relative humidity indicator shows a reading of 80 percent or more at the end of the test, the floor is too wet to be floored. If it shows a reading of less than 80 percent, flooring material can be applied.

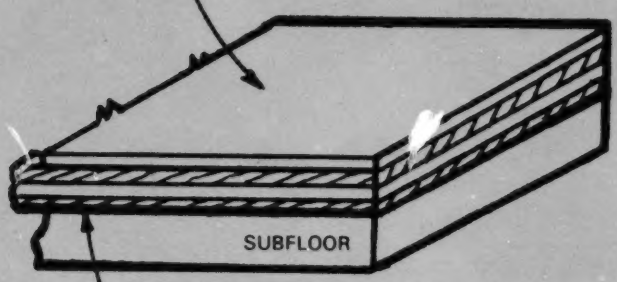
The floor must be primed just before the flooring is applied. When using primers, the floor coverer must be very safety conscious. Primers usually contain a large amount of an extremely poisonous alcohol. These alcohols are volatile and their fumes are explosive. For this reason, priming must be done only in well-ventilated spots. The subfloor must be dry and must have no hardening or curing agents left on it. Primer is applied with a trowel, a large brush or a squeegee. The primer is allowed to set. If gray spots appear in the coat, more primer should be applied. Finally the primer coat is allowed to dry. This usually takes about 12 hours. Trowels, brushes or squeegees are cleaned as soon as the application is finished. Tools are cleaned with the same type of liquid used to suspend particles of primer.

Dusty concrete floors or sanded-down wooden floors are first coated with sizing. Sizing is prepared by mixing equal parts of wax-free shellac and denatured alcohol. Denatured alcohol is extremely poisonous. Sizing must be applied only in well-ventilated places. Sizing is brushed or rolled onto the floor and allowed to dry.

Wooden Floor Preparation

On wooden underfloors made of tongue and groove boards which are 3 inches or less wide, plywood underlayment is used. First the subfloor is covered with roofing felt. The roofing felt is laid out so that it runs at right angles to the floorboards. The felt is cut with heavy shears or a knife. The sheets are butted together, not overlapped. Any overlap will show through to the final flooring. Therefore, the felt sheets must fit together precisely. Sheets are turned upside down to remove any curl. Half of each sheet is turned over, in turn, and the subfloor is swept clean. With a notched trowel the floor coverer then spreads a thin layer of adhesive on the floor. The roofing felt is folded down and spread evenly over the adhesive. Then the opposite side is folded back and stuck down. Each piece of felt is treated in the same way until the entire room is covered. Paste pots should be placed on top of scrap pieces of felt to protect the underlayment felt. Finally the entire room is rolled with a heavy roller. Then the plywood which is at least 1/4 inch thick is cut and laid out. Plywood should be solid core interior plywood A.P.A. underlayment grade. Sheets are laid out in *ashlar style*-the long side is parallel to the longer wall. Sheets are placed 1/64 inch apart. (This space will just allow a

paper matchbook cover to be wedged in between the sheets.) Finally the plywood is attached to the floor with 3d ring-grooved or cement-coated nails, spaced 4 inches apart on centers.



Subflooring is often uneven at doorways. Where this unevenness is small, flooring can be continued across the doorway. Preparing the undersurface of the doorway itself is called *"beveling the doorway"*. A length of lining felt, about 6 inches wide and long enough to cover the doorway, is cut. The felt is butted against the floorboards of the higher floor. A chalkline is snapped 4 inches wide and parallel to the doorway. Then a notched trowel paste is spread in the 4 inch wide area. The felt is spread out over the pasted area. There should be a 2 inch unpasted strip. When paste is dry, the unpasted felt is pulled up splitting in a bevel.

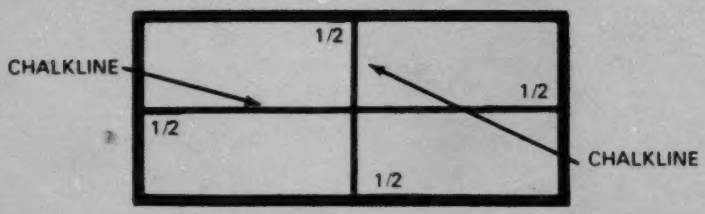
COVERING THE FLOOR

Once the subfloor is prepared, the floor is ready to be covered with tile or sheet vinyl. First, the floor coverer must estimate the amount of tile which will be needed by calculating the number of square feet in the area to be tiled. The number of tile needed will depend on the size of the tile used. If standard 9 x 9 inch tile is used, the number of square feet in the space to be covered should be multiplied by 1.7778. For 9 x 18 inch half as many tile will be needed as for 9 x 9 inch tile. For 12 x 12 inch tile the number of tile needed will equal the number of square feet in the floor. If 6 x 6 inch tile, four times as many tile will be needed as there are square feet in the floor space.

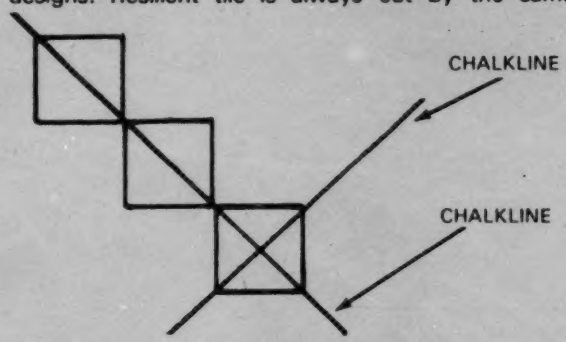
Allowance must be made for waste. Experts have calculated the amount of tile usually wasted and have come up with the following figures:

Area of workspace	*Addition for waste*
0 to 50 square feet	14%
50 to 100 square feet	10%
100 to 200 square feet	8%
200 to 300 square feet	7%
300 to 1000 square feet	5%
1000 or more square feet	3%

Once the amount of tile needed has been figured, layout begins. The first step in this job is to measure the perimeter of the room with a tape measure. Then the room is squared off, or divided into a series of squares. Chalklines are snapped around the squared off area. Half the length and half the width of the squared off part are measured off on the chalklines. Then the floor coverer takes the chalkline again and snaps chalklines, dividing the area in half in both directions. The room will end up looking like this drawing.



As tile is being laid it will have to be cut to be fitted into different courses or designs. Resilient tile is always cut by the same



processes. The tile is run until one tile fragment is needed to complete the course. This last tile is heated so that it softens slightly. The tile is turned upside down and laid on the floor,

butted against the wall. Using the last laid tile as a guide, the tile is cut with a curved linoleum knife. The tile is then fitted into place. Diagonals are cut in the same way except that the tile is rotated so that one edge abutts the wall; the opposite edge touches the corner of the last tile to be laid.

Tile sometimes must be fitted around irregularly shaped objects, or curved objects such as pipes. To do this, a course of tile is laid up to the obstacle. Then a tile is butted up against the obstacle. The floor coverer takes a carpenter's square and marks off two parallel lines as far apart as the diameter of the pipe. Then the distance from the end of the tile to the pipe is measured. This distance is marked off on the tile and the tile is cut to fit the object. If the object is not regular in shape, a pair of scribers is set to the distance which separates the last laid tile from the object. Then, as one leg of the scribers is moved along the object, the other leg traces the shape of the object onto the tile. This shape is cut out of the tile. Once the tile is cut to the desired shape, the exact fit is checked. If the tile fits smoothly, adhesive is spread with a notched trowel and the tile is fitted into place.

Installing sheets of resilient flooring is also simple. Whether the sheets are linoleum or sheet vinyl, the tasks are few and easy. After the subflooring has been cleaned and prepared, the room is measured from one end to the other in the direction in which the floor is to be laid. The first strip of flooring is unrolled face downward so that it will uncurl. The length of the room plus 3 inches is measured off on the strip. Then it is cut with a sharp, curved linoleum knife. The vinyl is butted against the end wall. A pair of dividers is set to the greatest distance between the wall and the sheet. One end of the dividers is run along the wall; the other is run along the sheet. The sheet is cut along this mark. With a notched trowel the floor coverer spreads adhesive over the floor. About 3 feet should be left uncovered at the opposite end of the room. Then the sheet is put into position and pressed into place. The free end is lapped up onto the other end wall. The dividers are opened fairly wide - say 10 or 12 inches. This distance is marked on the floor and a tick made next to it on the vinyl. Then the sheet is buckled back so that the end is butted against the wall. The distance between the mark on the floor and the mark on the sheet is measured. The dividers are set to this distance. One leg of the scriber is placed on the end wall, the other on the sheet. The scriber traces a line along the sheet. This will be the cut line. The material is then cut with a linoleum knife. After the fit has been checked, adhesive is spread with a notched trowel, and the sheet is fitted into place. The process then is repeated for the remaining strips of vinyl.

Seams In Floor Covering

As further sheets of vinyl are fitted into place, the seams must be tight. Three different ways of making seams are used. One way is called the *double cut method.* In this method two strips of resilient flooring are laid out side by side and slightly overlapping. Adhesive is applied along one side of one strip and along the opposite side of the other strip. Just enough adhesive should be applied so that both strips are bonded to the floor. However, both strips should have little enough adhesive that they may be folded back upon themselves. Then the two strips are stretched out so that they overlap. A straightedge is laid out over the overlapping parts and a cut is made with a sharp linoleum knife. After the strips are removed, adhesive is applied and the strips are fitted together. In the second method, after the two sheets have been laid out, the second sheet is placed over the first, and a scriber is drawn along the line where it begins to overlap the first sheet. The scribed line is used as a guide and the second sheet is cut to fit. In the third method, the abutting sheet is placed underneath the first sheet. The edge of the first sheet is used as a guide and the second sheet is cut to fit with a sharp linoleum knife. In all cases the cut strips are removed, adhesive is applied, and the strips, carefully butted together, are fastened down. The seam is finally rolled with a heavy roller.

These are the processes which a floor coverer laying resilient flooring follows. More complex tasks, such as making patterns, are just a combination of the basic tasks which are described here.

CARPETING FOR FLOORS

Carpets are made from a variety of different materials, and they are woven in several different ways. Most carpets are made from wool, nylon or acrylic. Wool has been used in carpets for centuries. It is tough, long-lasting and can resist a great amount of hard wear. Two problems with wool are that it is easily stained and it absorbs moisture. It is also an expensive material. Acrylic is similar to wool in many ways; in fact it is almost an artifical wool. Nylon is used in more than half of the residential installations these days and in more than a third of the commercial installations. Nylon has many advantages. It is fairly inexpensive. It is available in a wide variety of colors. Nylon is very strong and resists crushing, staining and spoiling by insects.

There are two other artificial fibers used in carpets: Polypropelene and polyester. Polypropelene is now used to weave indoor and outdoor carpets. This material resists stains and moisture extremely well. Polyester is resilient. It does not fade easily, and it

resists most insects. It is also resistant to dirt and may be cleaned easily.

Carpeting Features

No matter what material the carpet is made from, there are several features which should be remembered. The carpet should stand up to foot traffic. Nylon in particular resists wear. Carpet fibers should be able to resist chemicals such as acids or alkalis. Food, drinks and soaps all contain acids or alkalis, and carpets will be exposed to them. The carpet fibers should be able to stand up to them. Insects and fungi attack wool carpets, but cannot feed on synthetic fibers. Insects and fungi can be kept off wool fibers if the carpet is vacuumed and exposed to air. People frequently drop lighted cigarettes or other burning objects on carpets. Wool fibers will char; synthetic fibers will melt and fuse. Different fibers maintain their color and the texture differently. Some fibers are crushed by heavy foot traffic; others lose their texture. The rate of such wear depends mainly on how tight the yard is and how densely the pile is woven.

Carpets also differ in how much they are stain and soil resistant and in "wet cleanability". Many things found around a house will stain a carpet, such as oil, grease, eggs, chocolate, coffee and tea. The rate at which a fiber absorbs moisture is one factor in its stain resistance. Wool and nylon, which contain a lot of static electricity, tend to attract dirt and dust particles more than other materials. Tightly woven carpets hold dirt near the surface where it can be cleaned away, while loosely woven carpets tend to absorb dirt and hold it fast. Carpets which do not absorb water easily are considered more cleanable than carpets which absorb moisture easily. Polypropelene is considered an ideal "wet cleanable" material.

Carpet Weaves

There are five main ways of weaving carpet. The simplest weave is called the *tufted weave*. This is made by sewing tufts of yard onto a fabric backing. Tufts then are sealed in place by using a latex glue on the backing material. This is used mainly on cheap carpets. It is not durable.

Velvet weave is another simple weave. The pile is formed by looping yarn over wires and then tying the yarn back into the weft, which is composed of strands of yarn running cross-wise in the carpet. The wires are removed and the loops are cut. If the height of the wires is varied, different sized loops can be created. This can be used to create different textures in different parts of the carpet.

Wilton weave is similar to velvet weave except that different colored yarns are used in the weaving. As many as four different strands of yarn may be woven together in Wilton weave carpets, although only one strand surfaces at a time. For this reason, a wide range of patterns, textures and colors are available with this weave. The pile can be high in some spots, low in others and create almost a carved effect.

The *Axminster weave* can also be used to create patterns. The pile is even and cannot be varied to create a carved effect. Because so many different types and colors of yarn are used, the backing is very thick. Usually cardboard ribs are installed in the backing as supports, and, because of this, Axminster weaves can be rolled only in one way.

A weave rarely used today is the *Chenille* weave. The Chenille weave carpet is woven in two separate steps; in the first step, the tuft, a furry topping, is woven. Then the backing is woven. The two parts are sewn together. However, the two parts have a tendency to come apart under hard use.

WHAT A CARPET INSTALLER DOES

The basic tasks of a carpet installer are somewhat different from those of resilient floor installers. Again, the first thing done before carpet can be installed is to measure the room. On a regular room, measurements may be made by making overall measurements from end wall to end wall. This may be checked by measuring distances between doorways, across doorways, between other objects. These figures are added up and should equal the figure from the overall measurement. If the two figures differ, then the room should be remeasured. Often, carpet installers will make a freehand drawing of the room's layout as a handy guide. Once the

measurements of the room are known, the carpet installer then will estimate the amount of carpet which will be needed. The room is divided into its shapes: Rectangles, triangles and circles. These areas are added together to get the total area of the room. There are formulas which will give the area for the more common formats:

Area of rectangle = length x width
Area of triangle = 1/2 x length x width
Area of circle = 3.1416 x r2

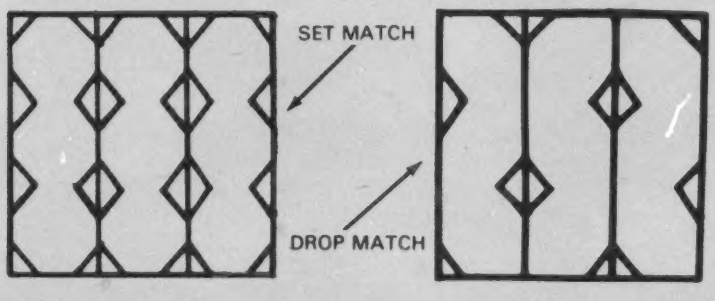
One square yard = 9 square feet

Preparing the Floor

The floor needs to be cleaned and prepared for the carpet. Where carpet is to be placed on wooden floors, the floor is cleaned, and splinters and protruding nail heads are removed. Cracks are filled with grout or plastic wood. The molding along the base of the walls is removed with a base shoe remover. Nails and tacks are removed. When the molding is replaced, new nails or tacks are used. A tackless strip then is laid out. Tackless strip is a strip of wood 1/4 to 1/2 inch thick and 3 or 4 inches wide which contains five or six rows of pins pointing up at a 60° angle. The strip is placed around the edge of the room to be carpeted; then the carpet is stretched out over the pins and pressed down onto them. The pins hold the carpet in place. The strip is carefully measured and cut with a hacksaw. The strips are placed in position with the pins pointing toward the wall. About 1/2 inch should be allowed between the top of the last row of pins and the base of the wall. On concrete, tackless strip can be glued to the floor with linoleum adhesive, or it may be nailed to the floor with powder-actuated equipment. Nails should be 6 to 9 inches apart.

Matching Carpet Patterns

One of the major tasks of the carpet installer is to match patterns in the carpet. There are several types of patterns which are com-



monly found. These are called set match designs, drop match designs and quarter drop match designs. In set match designs on 27 inch carpet, the design is not complete on one strip. It is completed when another piece of carpet is matched to it.

Drop matches have the other part of the pattern on the other piece, down one-half the length between patterns. Multiples of the repeat, or multiples plus half the repeat are used to match up sections of the carpet.

Quarter drop match patterns need four blocks before the figure repeats. For example, if a set match design repeats every 3 feet, it will be cut to match on the sides every 3, 6, 9, 12 feet and so on. If it is cut at other lengths it will not match. On drop match designs which have a 3 foot pattern, cuts are made at 3, 4-1/2, 6, 7-1/2, 9, 10-1/2 feet, and so on. Quarter drop matches can be matched for lengths of one quarter of the repeat plus a full block.

Laying Carpet Padding

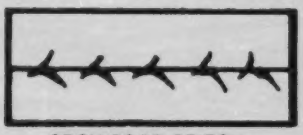
After figuring how strips of carpet will be cut, the carpet layer lays padding over which the carpet will be laid. Carpet is laid over padding so that it will not wear quickly and so it can be held in place more easily. Padding is usually made of thick sheets of felted wool or artificial fibers. Padding is laid out and fastened in a fairly simple set of steps. First, the room is carefully measured. Padding is laid out in a large, flat area. The padding is measured with a steel tape measure. At each place where cuts will be needed, 1/2 inch cuts are made with shears. Chalklines are snapped to mark the lines of cut, and then the padding is cut with heavy shears. Padding is then laid out and the pieces are abutted together ready to be installed. Padding can either be stapled, tacked or glued to the floor. If tacked, the outside edges are tacked together 6 inches apart. The outer edges are trimmed if tackless strips are to be used to hold down the carpet.

Taping or Sewing Carpet

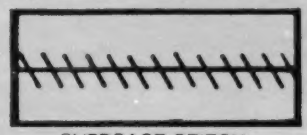
Carpet is joined by taping or sewing. The two methods of taping are called *face taping* and *back taping*. When a seam is face taped, it is unrolled and stay-tacked at one end. Three or four tacks are placed 2 or 3 inches from the edge of the carpet. Then the carpet is stretched with the knee kicker and stay-tacked 6 to 8 inches apart. The second strip of carpet overlaps the first strip slightly. The tape is unrolled and centered along the seam line. Sealant is applied to the tape with a brush or putty knife. The seams are fitted together tightly beneath the tape. The seam should not be visible beneath the tape. Sandbags are laid along the seam and the sealant is allowed to dry. Once the seam is dry it is rolled flat.

For back seam taping, the two pieces of carpet to be joined are batted together and stay-tacked. Then the pieces of carpet are folded back. The adhesive is spread 3 inches wide centered beneath the seam. The tape is laid out over the adhesive. Another coat of adhesive is applied to the tape and the carpet is folded down. The seam is then rolled with a roller.

The other way of joining two pieces of carpet is by stitching them together. Sometimes stitching is done in the carpet shop; other times it is done on the job. There are several different stitches used to join pieces of carpet. The *crowfoot stitch*, the most common, uses a curved steel needle. The stitch starts from the bottom of the overlapping carpet and is brought up and then across to the other carpet. The thread is taken down about 1/2 to 3/4 inch and pushed through the back of the next piece of carpet.



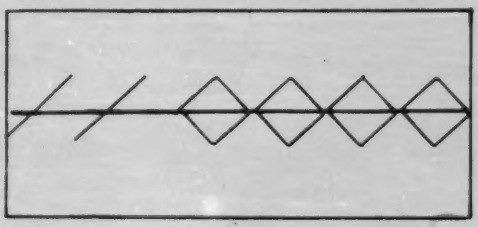
CROWFOOT STITCH



OVERCAST STITCH

This is repeated for the length of the seam. A second stitch is the *overcast stitch*. The overcast stitch is done on two pieces of carpet whose pattern and pile have been lined up. Overcast stitches are made with a straight needle and a double thread. The needle is pushed straight through both overlapping pieces. Then the thread is pulled down the seam at an angle for about 1/2 inch, and the process is repeated. *Cross stitches* are made by making

OVERCAST STITCH



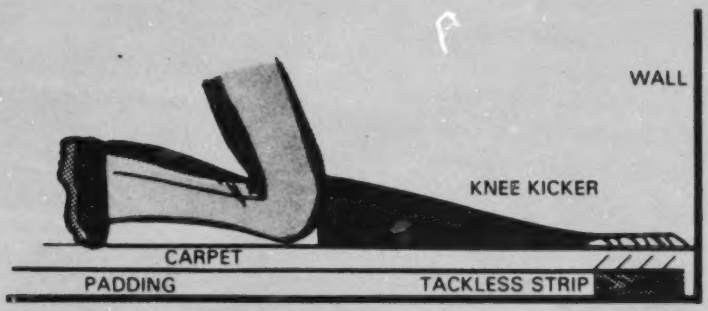
CROSS STITCH

two courses of overcast stitches over each other — one course angled in one direction, the other course angled the opposite direction.

Laying the Carpet

Once the strips of carpet have been joined, the carpet must be laid out and fastened. This is the major task of carpet laying. All other tasks lead up to this. Carpet laying means stretching the carpet and hooking it onto the tackless strip so that it is stretched

tight and hooked firmly. Two tools are commonly used for this purpose — the knee kicker and the power stretcher. The *knee kicker* is a tool which has a heavy head with protruding pins attached to a knee rest. The head embeds itself in the fibers of the rug and is pushed by the pressure of the carpet layer's knee. In the process it stretches the carpet. The *power stretcher* is very similar except that the head is pushed by a device similar to an automobile jack instead of by the carpet layer's knee. The power stretcher is butted against one end wall and the head is embedded in carpet along the other wall. A handle on the power stretcher is pumped to extend the power stretcher further. As it extends, the carpet is stretched.



Once the tackless strip and the under padding have been installed, the carpet is unrolled and positioned. One of the edges of the carpet is lapped up to one of the end walls by 3/8 inch with a small awl. The carpet is pressed flush to the wall with *finders*. The carpet is ironed down with a *carpet hammer*. The carpet is hooked to the tackless strip for about 1 foot along one corner of each of the walls. The carpet installer takes the knee kicker or power stretcher and stretches and hooks the carpet all along one of the walls. The carpet is ironed again with a carpet hammer. On the wall opposite, the power stretcher is used to hook the carpet into place. The carpet once more is ironed into place. The carpet is forced into the gully between the tackless strip and the wall by pushing it down with a small awl or putty knife.

One last problem carpet installers often have is fitting carpet around pipes, under radiators and so on. The carpet is turned back and the distance measured from the center of the pipe to the edge of the carpet. This line is marked off with a chalkline on the carpet's back. It is cut with carpet shears or a carpet knife. Flaps are cut around the fitting for the pipe. The carpet is laid around the pipe and flaps are folded under the carpet. The seam is sealed by face taping or back taping.

TOOLS AND EQUIPMENT

Floor covering installers use both hand and specialized floor covering tools. Because there is a considerable difference in the tools used for laying carpet and the tools used for laying resilient flooring, the tools will be listed separately according to use.

Tools for Resilient Flooring Installation

Dividers—heavy duty compasses made for scribing patterns on resilient flooring.

Dollies—used by floor installers to move heavy furniture and appliances. They usually consist of a low, flat frame set on small wheels or rollers and are moved by hand.

Electric heat guns—often used to heat tile and sheet vinyl prior to cutting or to melt down rough edges along seams.

Hand rollers—small rollers used in spaces where large heavy rollers will not fit.

Hundred-pound rollers—heavy steel rollers, often with two or three sections, used for rolling and pressing down felt and resilient flooring materials.

Linoleum knives—small knives with wooden handles. They are very sharp and specially curved for cutting resilient tile and sheets.

Notched-bladed knives—small knives which come with four or five interchangeable blades and are specially designed for the rapid cutting of sheet vinyl and felt.

Notched steel trowels—thin rectangular steel blades used for spreading adhesives. They have notches, similar to sawteeth, cut in the front and along one side.

Pinch bars—small crowbars used by floor installers to remove molding and to raise trim.

Sandbags—often used to weight down seams.

Scribing tools—heavy duty steel tools used for marking off curves and other lines on resilient flooring materials.

Straight edges—used by resilient floor installers are made of tempered saw steel. Often one end is cut with a 45° angle as an aid to mitering.

Tools for Carpet Installation

Awls — Small sharp-pointed awls are used by carpet layers to force carpet into the gully between the tackless strip and the wallboard.

Carpet hook knife — A carpet hook knife is a curved, point-tipped, thin, steel-bladed knife occasionally used as a substitute for carpet shears.

Chalklines — Chalklines consist of reels of yarn which are enclosed in a case and are saturated in chalk dust. Chalklines are used for marking off straight lines.

Hammers — The primary hammers used by carpet layers are tack hammers and regular claw-headed carpenters' hammers.

Knee-kickers — The knee-kicker has a head with adjustable steel needles or teeth for gripping carpet and a padded extension for applying pressure with the knee or hand.

Measuring tapes and extension rules — These instruments are used to measure rooms and determine where carpet should be laid. A measuring tape is simply a nylon tape marked off in feet and inches and wound around a spool. An extension rule is made up of thin slats of wood marked off in feet and inches which can be folded to fit in the pocket or extended to about 12 feet.

Needles — Heavy duty straight and curved steel needles are commonly used by carpet installers.

Pad knife — A pad knife is a curved, square tipped, heavy-duty steel knife used for cutting carpet padding.

Power stretcher — The power stretcher has a head similar to the knee-kicker head, with steel needles or teeth for gripping carpet and a long, telescoping tubular arrangement connected to a lever for applying pressure to the carpet and stretching it.

Shears — Carpet installers use a variety of different shears, or heavy-duty steel-bladed scissors.

Stair tool — A stair tool is a flat, wide, steel-bladed instrument used by carpet installers to force carpet into the crotch of stairs.

Stapling guns — Two types of stapling guns are used by carpet installers: One type is the stapling hammer which staples when its head is struck; the other has a handle which staples when it is squeezed.

SAFETY CONSIDERATIONS

Floor covering installation is not considered a particularly hazardous occupation. Accidents do occur, however, and safety precautions should never be disregarded. Remember that alertness and common sense are probably the most effective accident deterrents.

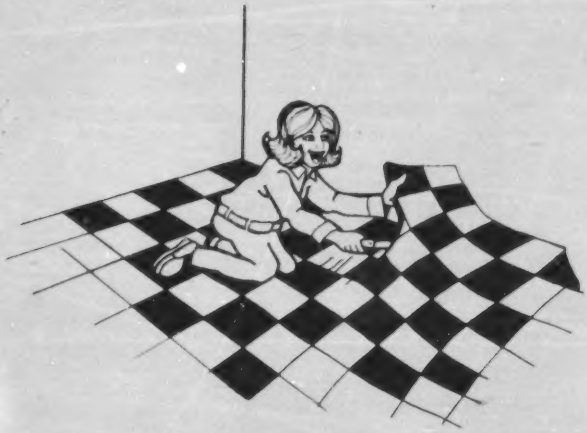
There are Federal and State safety codes which govern the conditions by which workers carry out their jobs, and in some areas

these codes are rigorously enforced. On most jobs, whether large or small, it is the employer's responsibility to see that safe working conditions and practices prevail at all times. Floor covering installers should constantly be on the alert for unsafe conditions and attempt to correct safety hazards or at least inform employers or supervisors of them. In most States an employee cannot be required to carry out a job if it violates safety laws and, therefore, cannot be discharged or laid off for refusing to perform unsafe tasks.

The job site should be carefully checked for hazardous conditions. It is important to have adequate lighting at all times. Openings in the floor, in sidewalls, on upper stories, staircases, shafts and elsewhere require guardrails. Equipment, tools and scrap material should not be left underfoot, and you should be careful to sweep the floor after using tacks. Wet adhesive, grease or water spills should be cleaned up immediately to prevent falls. Loose materials, tools and debris left by others on nearby scaffolds or ladders should be removed because they are easily knocked off.

Back injuries and knee ailments are probably the two greatest occupational hazards in floor covering installation. Knee ailments are common because the work requires a great deal of kneeling and certain tools, particularly the knee-kicker, place considerable strain on the knees. Back injuries are usually the result of improper lifting. A large roll of resilient flooring (or carpeting) is both bulky and heavy, and it is extremely important that the back be kept straight and the knees bent when moving these materials.

Finally, linoleum knives are sharp and can be dangerous. *Always cut away from yourself.*



AFTER GRADUATION

Toward the end of your senior year you will need to make a decision as to whether you want to seek additional training in floor covering or go directly to work. Even though you probably have a fairly accurate assessment of your capabilities, it would be wise to discuss your next move with your instructor or counselor.

If you decide to go directly to work, you will need to ask yourself several questions. Where do I want to locate? What kind of company do I want to work for? What type of working conditions do I desire? As much as possible, know what you most want out of going to work. Use this information as a goal, and set your mind to achieving it.

Going Directly to Work

Most floor covering installers are employed by flooring contractors who may specialize in commercial and industrial flooring work, in residential floor covering or in specific types of installations such as resilient tile. Many others work for retailers of floor covering who also provide installation service. Floor covering installers also are employed by furniture and department stores that sell and install floor coverings, as well as by home alteration and repair contractors.

Heavy concentrations of these workers are found in large business centers where high levels of both commercial and residential building prevail.

No national wage data on floor covering installers is available. However, starting wage rates for apprentices and other trainees usually are about half of the journeyman rate.

Most floor covering personnel, including those under union-management agreements, are paid on an hourly basis. In some nonunion shops, part of the installer's pay may be in the form of bonuses for work performed within a specified time period. In others, installers receive a monthly salary or are paid on the basis of the number of square feet or square yards of floor covering they install.

Floor covering installers generally work regular daytime hours. Particular circumstances, however, such as installing a floor in a store, or office, may require work during evening hours or on weekends when stores and offices are not open for business.

Floor covering installation work is usually not affected by weather conditions, since it is performed indoors. During the winter months most work is done in heated buildings. Job hazards are not numerous, but installers frequently experience knee injuries

because they do much of their work while kneeling; back injuries occur occasionally as a result of twisting and lifting on the job. Most of these injuries can be avoided, however, if proper work procedures are followed. Generally, an installer is assisted by a helper in heavy lifting, and has proper equipment available to move heavy objects.

More Education

In considering applicants for floor covering installation jobs, employers are particularly interested in those having manual abilities. They prefer applicants with a high school education, but this qualification is not generally required. Most employers seek applicants between 17 and 30 years of age having at least average physical strength. A neat appearance and a pleasant business-like manner are important attributes because the work is performed on the customer's premises.

Training authorities generally recommend a 3- or 4-year apprenticeship program as the best way to learn the floor covering trade. Most apprenticeship programs include 6,000 hours (3 years) or 8,000 hours (4 years) of on-the-job training, in addition to related classroom instruction. In these training programs, the trainee learns the techniques of floor covering installation and how to handle the tools of the trade. Through work assignments with skilled people on a wide variety of floor covering jobs, the trainee learns to plan and execute different types of jobs in a minimum of time and with the most efficient and decorative use of materials. Most apprentices are required to attend class twice a week to learn about the nature of the materials they will be using and the use and care of tools and equipment. They also study the mathematics of layout work, interpretation of architectural drawings and planning and layout of floor covering installations.

Some apprenticeship programs may combine training in the installation of resilient floor and wall covering with training in the laying of carpets. Other programs may be limited to the installation of resilient coverings.

Many workers in this trade have acquired their skills through informal training methods, such as working as a trainee or laborer, and observing or being taught by experienced floor covering installers. Many of these people also have gained some knowledge of floor covering installation by attending trade school or manufacturers' training courses, and through home study.

Many informal training programs limit the trainee's work experience to installation of resilient tile, or to residential floor covering work of limited complexity. This lack of all-around experience,

however, may be partially offset by trade school and home-study courses and manufacturers' training programs. A young person interested in becoming a floor covering installer should direct inquiries to several firms about their training programs before accepting employment as a trainee.

Skilled floor covering installers may advance to the position of supervisor or installation manager for a large floor laying firm. Some become salespeople or estimators for floor covering firms. Floor covering installers having business ability may form their own firms and employ their own installers.

GLOSSARY
FLOOR COVERING

Adhesive — sticky material often spread over subflooring with a trowel in order to hold resilient flooring in place.

Asphalt tile — tile composed of fibers and pigment bound together with asphalt.

Axminster—a type of carpet weave in which pile tufts are inserted and bound to the backing in a way which makes an extremely wide variety of colors and patterns possible.

Backing material—the material which forms the back of carpet.

Baseboard—the wooden trim along the bottom of a wall.

Binding—cloth sewn over a carpet edge to prevent unraveling.

Broadloom—broadloom refers to any carpet which is woven with a width greater than 27 inches.

Chalkline—a chalk-saturated length of yarn which leaves a mark when it is stretched and snapped over a surface.

Chenille—a carpet woven by inserting a weft of surface yarn tufts through fine strong warp yarns and over wool back yarn.

Knee-kicker—a carpet tool which has a padded cushion at one end and a head with fine rows of pins or "teeth" which grip the carpet. It is used to stretch carpet.

Linoleum—a resilient flooring material made of resins, cork, sawdust and pigments.

Linoleum knife—a thin, steel-bladed knife with a sharp, hooked blade. It is particularly useful in cutting resilient flooring.

Loom—the machine on which yarn is woven into cloth.

Padding—the cushioning material often found under rugs and carpets.

Ply—a layer of yarn in a carpet. "Three-ply" carpet, for instance, means that three yarns are woven together to make a tuft.

Power stretcher—a device with a "toothed" head, similar to that of a knee-kicker, telescoping tubes to be butted against walls, and a lever to apply pressure to the head. The power stretcher is used to stretch carpet.

Rows—the number of tufts per inch of carpet.

Scribe—to draw the exact irregularities of a wall onto a parallel sheet of carpet or resilient flooring.

Subfloor—the smooth level surface over which flooring materials are laid.

Tufts—pile fabric which has cut loops.

Velvet—a simple carpet weave used mostly for solid colors.

Vinyl—a wear-resistant resin used in making resilient flooring.

Weft—one of the parallel strands of yarn in textile weaves.

Wilton—a carpet weave in which several vari-colored threads are woven together to create the carpet. One colored thread is raised to the surface while the rest lie beneath the surface. Wilton weave is often used for patterned carpets.

APPENDIX
FLOOR COVERING

Armstrong Installation Manual, (Armstrong Cork Company: Liberty and Charlotte Streets, Lancaster, Pennsylvania 17604).

Duffin, D. J., *Carpet Installation Workbook and Training Guide*, (Van Nostrand Reinhold: 450 W. 33rd. Street, New York, New York 10001), 1962.

Duffin, D. J., *The Essential of Modern Carpet Installation*, (Van Nostrand Reinhold: 450 W. 33rd. Street, New York, New York 10001), 1962.

ADDITIONAL SOURCES OF INFORMATION

Asphalt and Vinyl Asbestos Tile Institute
101 Park Avenue
New York, New York 10017

Carpet and Rug Institute
P. O. Box 2048
Dalton, Georgia 30720

Resilient Tile Institute
26 Washington St.
East Orange, N. J. 07017

LANDSCAPING

INTRODUCTION

Opportunities in landscaping are many and varied, ranging all the way from unskilled jobs such as leaf raking and grass cutting to such professional areas as landscape architecture and ornamental horticulture. Let's look at opportunities which are neither professional (normally requiring a college degree) nor unskilled, but rather opportunities for such skilled workers as landscape gardeners, nurseryworkers, tree pruners and groundskeepers.

If you think you may be interested in a career related to landscaping, you should at least be aware of the diverse opportunities from which to choose. Although there are similarities in the work done by a nurseryman and a park caretaker, for example, one of the positions may appeal much more to you than the other. The following is a list of some of the occupations which can usually be entered by a student who has no training or only a minimum of training from a high school or trade school. The numbers which accompany the job titles are the designations they receive in the *Dictionary of Occupational Titles*, which can be found in your local library and can provide you with descriptions of the occupations.

Tree Pruner	404.884
Plant Digger	404.887
Nurseryman	406.168
Seed Grower	406.181
Flower Grower	406.181
Nursery Laborer	406.884
Ball and Burlapper	406.887
Tree Planter	406.887
Groundsman	406.887
Nursery Worker	406.887
Greens Keeper	407.137
Landscape Gardener	407.181
Park Caretaker	407.868
Grounds Keeper	407.884
Landscape Laborer	407.887
Cemetery Worker	407.887
Park Worker	407.887
Tree Surgeon	409.181
Tree Surgeon Helper	409.884
Yardman	413.887

If you prefer to continue your education by going to college, there are also a number of possibilities to choose from in selecting a

career related to landscaping. The following are some of the positions open to individuals with the required educational background.

Agricultural Sciences

Ornamental Horticulturist
Floriculturist
Agronomist
Forest Ecologist
Horticulturist
Olericulturist

Biological Sciences

Botanist
Plant Ecologists
Plant Taxonomists
Entomologists
Plant Pathologists

Professional

Highway Landscape Architect
Landscape Architect
Park Landscape Architect

As can be seen there are opportunities for working in a wide range of occupations related to landscaping. Education and training requirements, as well as individual preferences, are determining factors in making a selection from the many opportunities that exist.

WHAT A LANDSCAPER DOES

As has been noted, there are many jobs which relate to landscaping, from raking leaves or cutting grass to professional jobs in which entire gardens are laid out. These jobs require a person who knows how plants will appear growing together and what types of soil and climate each plant needs. Between these two extremes lie a wide range of jobs held by men and women who plant, water, fertilize and prune plants. Each sort of plant has its special pests, and the gardener-landscaper needs to know what these are and how to deal with them. In order to do this work a person needs some knowledge of botany or the science of plants. A knowledge of soils, how to test them to see whether they contain the proper chemicals for plants, and to apply proper fertilizers to the soil is needed. A person who does landscaping work also needs to be able to draw up a simple landscaping plan. Planting trees and shrubs is an important skill for landscapers, as is planting lawns. Installing watering systems and lighting is

another task. Many gardens have concrete structures placed in them, and the landscaper must be able to construct the forms, mix and place concrete for these structures.

A LOOK AT PLANTS

Let's take a look at each of these areas pertaining to landscaping. First, let us look at plants in general. Landscapers must know something about plants and how scientists classify them. Plant classification is a very large topic. It makes up the science of botany and would take several large books to explain in detail. However, we can very briefly discuss some of the ways plants are classified here. Similar plants are divided into groups. Each group is divided into subgroups of even more similar plants. The broadest group of plants is the *genus*. A genus is made up of plants all of which share a common characteristic. A *species* is a group of plants which are more like each other than they are like any plants outside the species. They have more than one major characteristic in common. A *variety* is a group of plants which are more like each other than they are to other plants in a species. They have one or a few characteristics in common which other plants in the species lack. Plants have both *common names* and *scientific names*. The common name is the name by which the plant is usually known. The scientific name is in Latin. It is made up of two words: The first word is the genus name to which the plant belongs; the second is the species name.

Trees

Let us look at the more common plants with which landscapers are concerned. Trees have certain characteristics which gardeners should keep in mind. Certain types of trees are useful for holding

the soil in place and keeping it from washing away. They provide shade in hot climates, and, if they are properly placed, can keep sidewalks and other open spaces cool in hot weather. In addition, some trees have very beautiful leaves during the fall. Trees whose leaves turn yellow or red during the autumn can be extremely beautiful, and gardeners who wish to plan for beauty will want to remember which trees do this. Still other trees have very distinctive bark and look very good in winter, as well as providing shade during the summer. Evergreens are trees which will maintain their green coloring even during the winter. Finally, rows of trees can be planted in gardens as windbreaks.

Shrubs

Shrubs are low plants which have several branches instead of a single trunk. Although some trees start growing branches rather close to the ground, shrubs branch out as soon as they are above ground. Shrubs often are grown because of their flowers. Also they make fine hedges and are often used as borders in the place of fences. When this is done, identical shrubs will be planted so that their branches will intertwine and grow together.

Flowers

Flowers are plants which are grown mainly for their blossoms. They come in many colors and sizes and can be grown in a wide variety of soils and climates. Some flowers appear on plants which live for many years without being replaced. These plants are called *perennials*. Others must be planted anew each year. These are called *annuals*. Flowers very often are reproduced from seeds or from bulbs. Bulbs are thick, nearly round shaped parts of a plant which develop just below the soil surface. Contained within them are the future leaves and roots of the plant. Tulips, irises, lilies and hyacinths are examples of flowers which grow from bulbs.

Grass

Other long lasting plants are the various types of grass. Grasses are used for lawns and they are excellent for holding the soil in place, because they have complex root systems which bind the soil tightly. Grasses are very hardy and almost every climate and soil will support some type of grass. There are some spots, however, where grasses simply refuse to grow; shady places or places where tree roots have taken most of the available moisture, or steep banks from which grass is washed off by water. In places such as this the gardener will look for some extremely strong plant to cover the ground and hold soil in place.

Foliage Plants

Some plants are grown because their leaves, or foliage, are attractive. Some plants for instance, have dark green shiny leaves. Other plants have large striped leaves, or leaves with odd shapes.

Other Plants

Plants are often planted indoors; those which do well are called *house plants*. Often, too, plants will be planted in long narrow strips at the edge of sidewalks, walls or lawns or other boundaries. These are called *borders,* and plants which do well when planted in borders are called *border plants*. Plants are frequently grown very close together so that each individual plant is not seen, but rather the plants run together to form a carpet-like effect. When this is done gardeners speak of *"bedding."* Plants which can be grown close enough together to create a bed are called *bedding plants*. Beds are frequently grown [illegible]. Any single plant which is grown or is studied is called a *specimen*.

Considerations in Planting

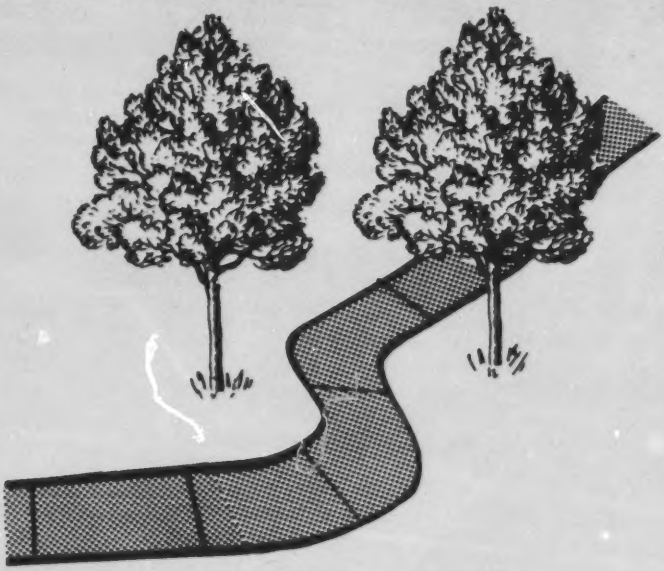
Landscapers are constantly deciding which plants to set out in their gardens. In making such decisions a wide range of things need to be considered. One thing which is important to note in a plant is how hardy it is. A plant is hardy if it can survive outdoor extremes of heat and cold. Gardeners must also consider the amount of sunlight plants need. Some plants need a great deal of sunlight; others grow best in dark places. Plants also differ greatly in the type of nutriment and soil required. Some plants thrive on soil with a lot of decayed vegetable matter; others do best in sandy soil. Some plants need a lot of moisture; others should be kept relatively dry. Further some plants are susceptible to insects and diseases.

Simple Landscaping

Once a gardener has some idea of the plants with which to work, landscaping plans need to be developed. At its very simplest, a landscape plan tells where each plant is to be placed. Before actually drawing a plan, the gardener should study the ground. Whatever design is made should be in harmony with the ground. The gardener should look at the whole area to be landscaped, not just at one part of it. Each part of the area is visualized as it fits into the whole property. One thing which the landscaper should note is the sort of view available. Is the land in a city or in the country? Are there mountains in the background or is the land flat? Does the property slope? If so, how much? What has been

done with neighboring property? As the landscaper thinks about these things, ideas are developed.

Spaces as lawn, garden, walk, drives should harmonize as much as possible. If a feature sticks out, if it is conspicuous, it does not belong. The landscaper should bear in mind how the grounds will look from inside the house, then determine how the grounds are to be used. For instance, if the grounds are for decoration, then several flower beds should be planned, and a nice lawn planned for and planted carefully. On the other hand, there will need to be few, if any sidewalks. If, however, people who will live or work on the property are going to spend a lot of time outdoors, shade trees probably should be planted, and paved areas and sidewalks



should be planned. People who want privacy may want a hedge or a wall designed for the border of their property.

LAND LAYOUT

In connecting all the parts together the gardener may be working with a very large area consisting of several acres, or there may be just a small area. In a large park or estate for example, the planner has to consider the lay of the land — whether it is hilly or flat. If the land is rocky, one sort of design is called for. If the land is sandy, it must be landscaped some other way. The amount of sunlight the land receives and the balance of sunlight and shade

to be achieved all must be considered. Whether the land is moist or dry is another thing to think about. If the soil is eroded considerations are needed on how to stop or prevent the erosion.

These are less pressing problems on small lots. On small property, its use will be sharply defined by the owners. The planner must choose between, say, a swimming pool and a flower bed. In small gardens vines growing on trellises can divide up spaces and yet take up little room. The planner will be much more concerned with fairly small plants which do not need large amounts of room.

Patios and courtyards take up little room, but in designing them, the landscaper must make sure they harmonize with the house. A patio is almost like an outside room. In patios there is often little room for flower beds so potted plants are used or very small plants are grown in small beds. In patios a small fountain can often be the center around which everything else is placed. Space is further consumed by paving material of one sort or another - usually a concrete slab or flagstones.

PREPARING THE LAND

Once the landscaper has decided how the land is to be used and has drawn up a landscape plan, the land has to be prepared for landscaping. To do this properly, the gardener must test the soil to find out what it contains and what it needs to have added to it. The level of the land should be measured with a transit. This will show what spots on the land are higher or lower.

Once this is known, spots can be determined to be *lowered, cut* or *filled.* The elevations and the amounts to cut and fill are marked on stakes which are driven into the ground. Cutting and filling may be done with graders and bulldozers on large plots, or with shovels and rakes on smaller pieces of land. Cutting and filling operations should provide a slight slope. Areas are sloped so that water does not collect and stand on it. Grounds should slope away from buildings at a tilt of at least one foot in each 100 feet. Drainage ditches or pipes should be installed, particularly around the location of any paved areas and flower beds. Drains should be at least 6 to 8 inches in diameter and should run at least a foot below the surface. They should connect with a stream, a dry well or the city's storm sewer system.

Testing Soil

While the land is being leveled, the soil can be tested. Soils vary in their make-up and before planting the gardener should know the type of soil. In testing, about 1/4 cup of soil can be taken and poured into a pint of water in a quart jar. The lid is put on the jar

and the jar is shaken and left undisturbed for several days. Several distinct layers of particles will collect. The first will be fine sand, then silt particles and, finally on top, clay particles. Samples which are more than 1/2 sand are light, sandy soils. Soils containing more than 1/4 clay are clay soils. The ideal soil is called *loam* and contains about 2/5 sand, 2/5 silt and 1/5 clay.

Soil Requirements

In addition to these minerals, soil needs humus. Humus is matter which has at one time been alive, either as plant or animal, and is being decayed by bacteria. As humus decays, it adds material needed by plants to the soil. Each loam should be made up of at least 1/10 humus. If there is not enough humus in the soil, more can be added by mixing in compost, manure, leaf mold or peat moss. Compost is manufactured in compost heaps from cut weeds, leaves and branches. Peat moss is dug from bogs where plants have been slowly decaying for millions of years. Leaf mold comes from the floors of forests where layer upon layer of leaves have been decaying for centuries.

In addition to humus, soil needs the right acidity and alkalinity balance. Acid soils, or sour soils, are good for some plants. Holly, cranberry, rhododendron and several other plants need acid soil. Alkaline soil, or "*sweet*" soil, is good for iris, clover, cabbage, lilacs and other plants. Chemists express the acidity or alkalinity of soil by what they call the *pH scale*. This scale varies from 0 to 14. Seven is the midpoint of the scale and expresses a substance which is *neutral* - that is neither acid nor alkali. Below 7, substances are acid; above 7, substances are alkaline. Most plants grow in the range between 6 and 7. Because of this, most gardeners try to maintain a pH of about 6.5. If the grounds need to be made more acid, sulfur should be added. One half cup of sulfur each 9 square feet will lower the pH about a point. Pine needles, sawdust and leaf mold from oak and beech trees add acid to the soil.

Lime should be added for alkalinity. Anywhere from 50 lb. to 100 lbs. per 1000 square feet will increase alkalinity. On clay soils, 100 lbs. per 1000 square feet is a good dosage. This amount will cause small particles of clay to clump together. In turn, this opens up air and water spaces in the soil. Wood ashes and ground oyster shells will also add alkalinity.

Finally, there are three chemical elements which should be checked in the soil. They are potassium, nitrogen and phosphorus and can be checked at an agricultural experiment station. If there is not enough of each present, they should be supplemented by

adding chemical fertilizers. The best time to obtain a sample for testing is in early Spring or late Fall. A small hole, 6 or 7 inches deep, should be dug with a trowel. Once the hole is cleared out, a small slice off the adjacent soil should be made, much as a cake is sliced. The sample should be dried and sent to the county agent or agricultural experiment station.

Soil Fertilizers

Once the soil is analyzed, some type of fertilizer will probably be recommended. Several kinds of fertilizer are on the market, and there are different means of applying fertilizer. As noted, there are three elements which plants need. They are potassium, nitrogen and phosphorus. Fertilizers are developed from animals or plants; others from minerals. Fertilizers from animals or plants are called *organic fertilizers*. Those which come from minerals are called *inorganic phosphates*. In recent years fertilizers which contain all three of the basic elements have been developed and are called *complete fertilizers*. Nearly all the complete fertilizers are inorganic. They are packaged with a series of three numbers which describe them. For instance, there are 2-6-2, 5-10-5, 15-30-15 and so on. These three numbers give the percentages of nitrogen, phosphorus and potassium in the fertilizer. Complete fertilizers are usually sold in powdered form. The powder is dissolved in water and poured onto the plant bed.

Spreading Fertilizers

There are several ways to spread fertilizer. Dry powder or granular fertilizer may be spread from a mechanical spreader. This is called *broadcasting*. Usually broadcasting is done in the Fall or right before planting in the Spring. The fertilizer should be worked two or three inches into the ground and then the entire field should be watered. Another method used is called *side-dressing*. In side-dressing a band of fertilizer is laid out eight to twelve inches wide and beginning six inches away from the base of the plant. Too much fertilizer applied will burn the leaves and roots of the plants. Usually corn, snap beans and tomatoes are side-dressed. Still another method is the *starter solution*. Starter solutions are solutions of fertilizers in water which are poured around the roots of a plant as it is set out.

Planting

Once a gardener has prepared and fertilized the ground, it is ready for planting trees, shrubs, garden plants and lawns. There are a wide range of ways to plant. Usually trees and shrubs are planted when they are quite young and rather small. No matter what is

planted there are certain basic steps to be followed. The gardener-landscaper selects a good, strong snub-nosed shovel to dig the hole into which the plant will be set. The hole should be dug wider and deeper than the root system of the plant. Once dug, a couple of shovelfuls of good, loose, rich soil should be thrown into the hole. The plant should be placed in the hole with the most attractive side toward public view. Soil should be shoveled into the hole until it is about 1/2 full. Then the plant should be watered until all air pockets escape. Once air has escaped, the hole should be filled up the rest of the way until the soil is even with the ground around it. The plant should be watered again. The gardener should drive in stakes on three sides

of the plant, about 10 feet away from it and tie twine to the stake and to the top of the plant's trunk. This is done to help hold the plant in place. Planting is almost always done in very early Spring before the growing season starts, or in late Fall after it has ended.

In addition to planting shrubs and trees, gardeners also plant lawns. Many different kinds of grasses are used. There are two basic types of grasses - *southern grasses* and *northern grasses*. Southern grasses are those which do well in the southern half of the country. They need hot summers and mild winters. The northern grasses are grown mainly in the northern half of the country. They do extremely well with very mild summers and they can easily survive cold winters. There are several different types of grass grown in each region.

GRASSES FOR PLANTING

In the North, Kentucky bluegrass is the favorite. It adapts well to a wide range of cool climates. It can take very dry weather, without difficulty. Further, it resists most insects and plant diseases. Bare areas of lawn are soon filled in by bluegrass spread from runners, but it does not take over flow[illegible]ds. Its spread can be controlled, and it is hardy - it resists [illegible]s and weed killers. Not only does it grow well in a fairly [illegible]nge of climates, but it can grow well on a wide range o[illegible]s. A relatively small amount of seed is necessary to start a lawn. Finally, bluegrass mows easily. During dry summers bluegrass will turn a light brown.

Because of this several other grasses are used in the North. Red fescue will grow well with a wide range of moisture levels. Differences of soil types do not bother it. It grows well in shady spots. It has a fine, soft velvety texture. Mixtures of red fescue and bluegrass seeds are very often planted so that lawns are made up of a combination of both types of grass.

Tall fescue is a thick stemmed, coarse grass which is particularly useful where grass is trampled heavily.

Bentgrass, on the other hand, is velvety with thin leaves and stems. It requires much care and work. Bentgrass is usually planted on golf courses and the lawns of very expensive estates.

In the South, Bermuda grass is as popular as Kentucky bluegrass is in the North. Bermuda grass grows rapidly and forms a dense turf. It can be mowed very closely and thrives on heavy use. However, it will take over a flower bed unless a metal or concrete edge is installed. Bermuda grass does not grow in shaded areas, and it also requires frequent mowing. It comes in a wide range of colors—from yellow-green to blue-green.

A grass which does better in shade than does Bermuda grass is zoysia. It is available in three major types. All the zoysias are hardy and resist wear and trampling very well.

Three other grasses which are less able to take trampling and traffic are St. Augustine, centipede and carpet grass. These grasses have rather wide, flat leaves. St. Augustine does especially well in shady areas. However it grows best only in the deep South and along the Gulf Coast. Although St. Augustine is easy to manage, it is susceptible to chinch bugs and to plant diseases such as brown patch and leaf spot.

Centipede grass has few problems with insects or diseases. It grows well in fairly shady places and infertile soil. Although it requires little care, it does not wear well under hard use.

Carpet grass resembles St. Augustine, but does not do as well in shady places. It is grown in infertile, sandy soils.

PLANTING GRASS

No matter what type of grass is grown, there are two ways to plant it. Grass is either grown from seed, or else sprigs or blocks of sod containing already grown grass are laid down. If a lawn is to be seeded, it should be worked about 6 inches deep. Before the soil is worked, a complete fertilizer with equal amounts of the three main elements should be applied. About ten pounds of fertilizer should be applied to each thousand square feet of ground. When grass is seeded in late Fall, only half the usual amount of nitrogen should be applied. This means that the fertilizer should have a ratio of 1-2-2. The ground should be raked and leveled. The seeding rate, the amount of seed to be planted per thousand square feet, varies with the type of grass. For instance, Bermuda grass should be seeded at a rate of one pound per thousand square feet; while fescues in certain dry loose soils should be seeded with six pounds per thousand square feet. Grass seed can be sown by hand or from mechanical seeders. It should be sown by hand over small areas and on a still day. It is a very good idea to sow the ground twice - once going North and South and the second time distributing the other half of the seed going East and West.

Mechanical seeders which roll on rubber wheels and are pushed are the best way of seeding ground. With them it is possible to get even seeding. After the seeds have been distributed, the seedbed should be raked lightly. The seeds should not be covered more than 1/8 inch. The bed should finally be rolled with a metal roller and sprayed with water. In some places the ground is then covered with a soft, light cloth. The ground should be kept moist until grass sprigs appear.

In addition to seeding, a ready grown grass may be placed on grounds, and a new lawn may be started this way. There are three ways to plant grown grass. They are *plugging, sprigging* and *sodding*.

- *Plugging* simply takes small clumps of grass and plants them at evenly spaced intervals in rows. Usually, the clumps are 12 inches apart in both directions. Plugs are from two inches to four inches wide. The ground should be worked to about 6 inches deep and fertilized. Holes for the plugs are dug, and they are pressed into place. The ground is then watered thoroughly and kept moist until the plugs begin to grow.
- *Sprigging* is done with bare roots and stems from already established grass. After the soil has been worked, sprigs are set

out in the trenches at 12 inch intervals. The soil should be raked to make small trenches. Then the roots are raked gently to cover them with a light layer of soil which is then watered.

- *Sodding* takes a turf which has been carefully cut in layers and spreads it out on prepared soil. It is used on slopes where grass seeds would wash away. One advantage of sodding is that it provides a lawn immediately. The sod blocks or strips are laid in place. Finally, it should be watered and rolled thoroughly.

INSTALLING GARDEN ACCESSORIES

In addition to planting, landscapers will need to install various garden accessories such as lighting and watering systems. Lighting and watering systems are manufactured by many different companies. Each has its own special directions. These should be studied carefully before installation.

Let's look at *watering systems*. Underground sprinkler systems give plants the deep water they need. If plants are sprinkled lightly, they develop shallow roots and are easily pulled up or dry up. Grass should be watered deeply at least 6 inches and it is better to water it 12 inches deep. The steps to take in drawing up a plan for a sprinkler system are first to calculate the area which should be watered. Then any obstructions to the system should be located. Obstructions include such things as sidewalks, buildings, walls and so on. The landscaper then takes a pressure gauge and measures the pressure of the water flow in pounds per square inch (PSI). Then the number of sprinklers are calculated which would operate at that pressure, considering the distance the water will travel and the diameter of the pipe. The pipe is laid out above ground. A trencher is brought in to cut a small ditch between 4 and 6 inches wide and about 7 inches deep where the pipe is to be laid. The sprinkler system then is connected as any other piping system, and covered.

There are a number of very good reasons for *installing lighting*. For one thing it shows up the beauty of the landscape. It lights up sidewalks and lets strollers see places where falls could occur. People can work or play outside for longer periods. Last but not least, a good lighting system discourages prowlers.

Depending on what is to be lit up and what its purpose is, lights may be either incandescent or fluorescent, either direct or indirect, colored or white. Some plants require more light than is available. In addition, some plants may be grown with artificial light which otherwise would not grow. Trees and flowers are usually best lighted if lights are placed at the side rather than in front. Paths are best lighted by low lamps which shine directly on the steps. Some lighting systems are automatic, so that they turn on and off at a set time each day. Others can be adjusted to give brighter or softer light. Some lighting systems are fixed in place and wired through underground metal conduits; others are portable or are plugged into ordinary wall sockets. No matter what system is used, the landscaper should be extremely cautious in installation.

CONCRETE USE IN LANDSCAPING

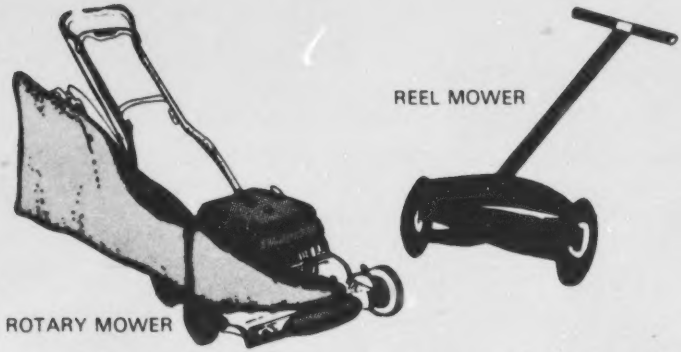
Landscapers also construct concrete objects used in landscaping. These may be slabs, steps, benches, borders for flower beds and the like. Usually, these are made from wooden forms. Forms for concrete are built from 3/4 inch plywood, 2 x 4's, 2 x 2's and 1 x 4's. The lumber should be carefully cut to the proper length and nailed or bolted together. The forms once built, should be treated with *form release compound* to make sure they do not stick to the concrete. Once the forms are assembled, concrete should be mixed and placed. Then it should be screeded and troweled. After it has set, the forms should be removed. (See the *Masonry* section on "Concrete.")

MAINTENANCE IN LANDSCAPING

Once a garden or landscape is actually in place, it needs maintenance. Lawns must be mowed and fertilized. Herbicides must be applied. Trees and shrubs need pruning. Plant diseases and harmful insects must be controlled.

Mowing Lawns

Let's look at some of the ways these things are done. The first job is mowing lawns. Two types of mowers are used - reel and rotary. Reel type lawn mowers have long narrow blades and cut as scissors do. Reel mowers can cut grass shorter than rotary



mowers. They can be adjusted to cut at a height of 1/2 to 2-1/2 inches. Reel mowers have anywhere from five to seven blades.

Rotary mowers must have sharp blades or else they merely tear the grass. Although rotary mowers are very useful for cutting tall, thick patches of lawn, they can be dangerous if one of their blades hits a rock or a bottle.

Different grasses must be cut to different heights. Narrow-leafed grasses, such as Bermuda grass, can be cut as short as one inch. Bluegrass may be left anywhere from 1 to 3 inches high. Grasses with broad leaves should be allowed to grow taller - 2 or 2-1/2 inches. Lawns should be mowed whenever the grass has grown 1 inch since the previous cutting. If only a small amount of grass is cut, it should be left on the ground to form humus. If, however, large amounts are cut, it should be raked off. Heavy toppings of old grass interfere with the growth process.

Fertilizing Lawns

Lawns need to be fertilized, as well as cut. The gardener needs to have a soil test done to determine what elements the lawn actually needs. No matter what sort of fertilizer is used, it should be spread by a mechanical spreader to make sure that it is evenly distributed. Complete fertilizers usually should be used, because grasses need the three main elements nitrogen, phosphorus and potassium. Generally speaking, bluegrass should be fertilized early in the Autumn; Bermuda grass should be fertilized both in early Spring and early Autumn. However, the timing will vary with the type of soil and the climate. After the fertilizer has been applied, the ground should be watered deeply.

Even if the lawn is well-kept, unwanted plants and weeds will grow. The best defense against weeds is a thick, healthy turf, but, these natural defenses have to be helped along. To help gardeners

do this, many different herbicides have been placed on the market. The first thing the gardener can do is to become familiar with the weeds in the local area. There are illustrated books on local weeds for almost every part of the country; gardeners should have those books which refer to their region.

There are several ways weeds may be controlled. They can be chopped or hoed. They can be pulled. They can be sprayed with herbicides. Although herbicides can be effective, many of them have been outlawed because they are *too* effective. Herbicides will often be washed off by rains and be mixed in with river water and kill plants miles away. Or herbicides will be blown onto neighboring land where they kill useful plants. To prevent this, herbicides should be biodegradable — that is, they should be destroyed by natural processes after a short time in nature.

Watering Lawns

In addition to weeding, lawns should be watered and aerated regularly. Anytime the lawn is watered, it should be soaked 6 to 12 inches deep. Shallow watering is bad for grass, because it causes the plant to develop a shallow root system. Lawns should be watered fairly often in hot, dry places during summers. On the other hand, in areas which have cool, damp summers, lawns should be watered hardly at all. Lawns should be watered late in the evening so that more water actually soaks into the ground and less evaporates.

Pruning

Just as lawns must be mowed, trees and shrubs must be pruned. Pruning is cutting away excess branches from a tree or a shrub. There are several reasons for pruning. Gardeners prune trees to remove dead branches. Often, diseased branches will be cut off before they can infect the rest of the tree. Fruit trees which are properly pruned will give better and larger fruit. Properly pruned trees will also put forth new and vigorous branches. Also, because the branches of a plant should never be thicker than the root system, branches will often be cut when the root system has been injured - as, for instance, when trees are transplanted. Flowers are pruned by cutting off many of the buds, and old blooms. This usually means that the buds which remain give larger flowers. Pruning is usually done with pruning shears or saws. Then the pruned area is painted over to protect it. Pruning should be done so as to leave a clean cut. No ugly stumps should be left. Usually, pruning is done in the late Winter or early Spring.

Fertilizing Trees and Shrubs

Trees and shrubs need to be fertilized just as do other plants. As with grasses, the three major elements which plants need are nitrogen, phosphorus and potassium. Different trees and shrubs need different amounts of each element. However, fertilizers should be applied in a circle about the plant beginning 6 to 12 inches outside the outer branches of the plant. Usually it should be done in Spring before the plant starts to grow. Organic fertilizers such as blood, bone meal, sewage sludge or cotton seed meal often are used. Frequently too, root feeders are used. A hose will be connected to a needle shaped feeder which is plunged into the ground among the plant's roots. A fertilizer cartridge is placed

in the feeder. The cartridge is melted by the water, and food is carried directly to the plant's roots. After fertilizer has been applied the plant should be watered.

Gardeners should be able to control insects and plant diseases. Diseases and pests vary widely from plant to plant and different parts of the country. Plant diseases are usually controlled by chemicals. However, many pesticides have long lasting side effects and harm other creatures. For this reason, a person should be very careful before applying them.

TOOLS AND EQUIPMENT

Power and hand tools are listed in this section under a job title. The tools will be listed only once under the title where they are most frequently used. A particular tool may be used in many areas of landscaping, though.

Park and Grounds Maintenance

Clippers

- Hedge - Both hand and electric clippers are used to keep hedges neatly trimmed.
- Grass - Both hand and electric clippers are used to trim grass around plants, sidewalks, etc.

Edgers

- Hand - Scissor-like tool used to cut grass at the edge of walks and drives.
- Power - Electric or gasoline powered machines used to cut grass at the edge of walks and drives.

Fork, Garden—Multi-pronged tool with wooden shovel handle used to dig bulbs, etc. in soil.

Hoe—Used to cultivate weeds, mix cement and perform general garden chores.

Hose—Plastic and rubber hoses are indispensable for watering, spraying and washing, especially with new hose-end attachments.

Mower—Electric and gasoline powered reel, rotary and sickle blade mowers are used to cut grass and weeds.

Pruner—A hand tool used to cut small limbs.

Rakes

- Leaf - Light rake used for gathering leaves, grass, clippings, etc.
- Road - Heavy garden rake used to level and work soil, gravel, sand, etc.

Sprayers

- Hose-end - Numerous types of sprayers which attach to hose ends for use in spraying insecticides, fertilizers, etc.
- Compression - Hand pumped sprayers which usually have a 2-6 gallon capacity.
- Power - Electric and gasoline powered sprayers have high pressure and large capacity. They are used to spray heights and large areas.

Sprinklers—Automatic and manual devices used to water a particular area of a lawn, golf green, etc.

Landscape Nurseryman, Retail Nurseryman, Garden Center Employee, Landscape Contractor

Aerator—Hand or gasoline powered device which places small holes in soil to allow circulation of air.

Hammer—The claw-hammer is an indispensable hand tool used in construction landscaping.

Level—An instrument used in construction landscaping to level a surface such as cement, a rock or brick wall, a fence post, etc. It usually consists of a tube containing alcohol or chloroform mounted in a frame. By aligning the bubble in the liquid, horizontals and verticals may be checked.

Shovel—A hand tool with a sharp metal tip and wooden handle used for planting, transplanting, excavating, etc.

Spreader—A device which is calibrated to spread adjustable amounts of fertilizer, seeds, peat moss, lime, etc.

Square—A steel carpenters square, usually 24 inches by 16 inches, is used for laying out and squaring in many areas of construction landscaping.

Tape—Usually of steel construction, retractable and 100 to 200 feet in length, tapes are used in all types of landscaping measurement.

Tiller—A gasoline-powered tool with curved blades which rotate and pulverize the soil. It is good for mixing soil conditioners into flower beds, gardens, etc.

Transit—An instrument used to measure grades, angles and heights in construction landscaping.

Trowels

- Garden - A hand tool which usually has a rounded wooden handle and curved steel blade and is used for small planting jobs.
- Brick - A flat, pointed hand tool used to handle mortar, as in bricklaying.
- Cement - A flat, rectangular tool used to smooth cement or plaster.

Wheelbarrow—Various types of carts used to transport soil, sand, trash, etc. They are also used occasionally to mix and transport cement.

Tree Expert

Ladder, Extension—Wood or metal constructed ladders capable of extending 20 or 30 feet and longer are used to reach limbs to be cut in very tall trees.

Pruner, Pole—A telescoping wooden or metal pole with a cutting device on the tip capable of cutting small, hard-to-reach limbs.

Rope—Strong fiber (hemp) ropes are used to attach to climbing saddles and permit safe maneuvering while working in trees.

Saddle, Climbing—A device made of strong, pliable material such as leather or nylon, used to attach to climbing ropes and support climbers in many different positions while working on trees.

Saw, Hand Pruning—Heavy-duty, metal-bladed, wooden handle saws with large, wide-set teeth are often used for cutting limbs.

Saw, Power—Electric and gasoline powered saws, often called chain saws, are used to cut large and small limbs.

Shears, Lopping—Long-handled, small-bladed shears with a very high mechanical advantage often used to cut small limbs.

Wholesale Nursery (Grower)

Tractor—Usually small, gasoline-powered machines which are used to plow, harrow and cultivate nursery stock. Tractors are also used to operate spraying, watering and fertilizing equipment, and to transport workers, supplies and nursery stock to and from fields.

Numerous other tools which have been previously mentioned are also used in wholesale nursery operations, including shovels, hoes, trowels, pruning saws, lopping shears, hand pruners, wheelbarrows, spreaders, sprayers, tillers, rakes, hoses, sprinklers, garden forks, etc.

Greenhouse (Grower)

Fertilizing System—Many modern greenhouses have automatic fertilizing and watering devices which supply each individual container with a given amount of liquid fertilizer and water as needed.

Sterilization Apparatus—Both portable and stationary equipment is used which is capable of producing 180 degree Fahrenheit steam in order to kill harmful organisms in soil mixtures. Where steam is not used, chemicals such as methyl bromide and vapam accomplish the same goal.

Numerous tools previously mentioned are also used in greenhouses such as trowels, sprayers, tillers, tractors, hand pruners, hoses, etc.

SAFETY CONSIDERATIONS

Most occupations in the landscaping field are not particularly hazardous providing that common sense and alertness are exercised. Tools can be a major source of accidents, usually because they are not properly maintained, because they are used for a purpose other than that for which they were designed, or because the victim of the accident was unfamiliar with the correct operation of the tool.

Power tools are particularly dangerous unless adequate precautions are taken. It is essential that one be familiar with the dangers inherent in any power tool being used. Electric power tools should not be used while standing on a wet surface, unless the tool is specifically designed for that purpose. A three-wire conductor should be used and care should be taken to ensure that the tool is properly grounded. Power tools should never be lifted or carried by the cord.

Cuts and lacerations are usually the greatest dangers associated with the use of hand tools. Pruning saws, grafting knives, lopping shears and axes are especially dangerous in this respect.

Certain areas of landscaping deserve special mention regarding safety. One of the most obvious of these is tree pruning. The proper use of strong climbing ropes and saddles is a must due to the great heights involved in cutting limbs from tall, mature trees. Precautions must be taken when pruning limbs or cutting down a tree which is near a high voltage line, because electricity can flow back to the worker through a damp, green limb in contact with a hot line. Hard hats should be worn by ground personnel during pruning operations due to the danger of falling limbs, saws, etc.

Another area deserving mention is the proper use of rotary mowers, whether they are standard-sized lawn mowers or large tractor mowers. Because of the high number of r.p.m.'s at which a cutting blade normally spins, any loose objects contacted can be sent flying at a tremendous velocity, much like a projectile fired by a gun. Prevention is the best course to take when dealing with rotary mowers. If lawns are kept clear of loose foreign objects, there is nothing but vegetation for the cutting blade to come in contact with. Also, some type of shield should be placed around the mower housing and exit area, especially on back-mounted tractor mowers.

Finally, there are numerous dangers associated with chemicals used in the landscaping industry—insecticides, fungicides, herbicides, etc. Some of these chemicals can be relatively harmless to handle and use for a brief period of time, but extremely dangerous and even fatal over extended periods. The safest approach in using these chemicals is to avoid contact with skin and eyes, take steps to ensure good ventilation and *always* consult the manufacturers' safety precautions.

AFTER GRADUATION

There are a number of job opportunities in landscaping for an individual who has no training or a minimum of training received in high school or trade school. Working for a private employer is a good way to enter this field since past experience is usually not required for unskilled or semi-skilled jobs in landscaping. It is possible to learn the skills for many landscaping-related jobs while working and progressing in earning power.

As long as America's economy is reasonably sound and the work week continues to grow shorter, the boom in landscaping and its related areas should continue. There is an increasing interest in beautifying home sites, playgrounds, parks and areas around public buildings and along highways. This means there should be increased job opportunities for individuals interested in growing or selling plants and landscape materials, landscape designers, landscape gardeners and related areas.

A majority of these jobs will require a fairly large degree of physical exertion and involve working outdoors in all types of weather. There are some jobs, however, which involve predominantly inside work. These include jobs in garden centers, greenhouses and florist shops.

For the most part, beginning wages are comparatively low for trainees in landscaping, but there are firms and institutions in some areas which have very good pay scales. Civil service

employers usually require applicants to have some experience in grounds work or gardening, in addition to passing a written Civil Service examination. This means that if you hope to work for a public agency, working for a nursery or a landscape gardener while still in high school is a good idea in order to gain experience.

The individual with a minimum of training can have a fulfilling future if interested in the work and is willing to produce for the employer. There are ample opportunities for advancement in pay and responsibility for those trainees who are interested in becoming supervisors, superintendents or managers.

For students with the necessary initiative and capital, there is the possibility of starting a business of your own. With a minimum of capital, one could start a tree pruning service, lawn service or nursery business provided you are willing to work hard. You would naturally need considerable experience before going into business for yourself.

More Education

Higher education is not an absolute necessity for success in landscaping, but it can prove beneficial in widening job possibilities and may increase earning power and chances for advancement. The student with the interest and qualifications has a wide range of fields relating to landscaping from which to choose.

There are institutions of higher learning throughout the United States which offer courses in agricultural science, biological science and landscape architecture. Although few people have the interest, initiative and perseverance to pursue, for example, a doctorate in horticulture, there are increasing numbers of students ursuing bachelor's degrees in landscape architecture—and for good reason. With the explosion in leisure time activities in recent years and the surge of construction of parks, lakes, golf courses, etc., there is an increasing need for landscape architects to keep pace with these activities.

Bachelor's degrees in landscape architecture are offered by at least 64 colleges and universities, of which 24 have been accredited by the American Society of Landscape Architects. Another 40 schools offer courses in landscape architecture, but not a complete 4-year program. The curriculum for the bachelor's degree requires 4 to 5 years of study, depending on the institution.

Entrance requirements for landscape architecture courses are usually the same as those for admission to the liberal arts college of the same university. Some schools also require completion of a high school course in mechanical or geometrical drawing, and

most schools advise high school students to take courses in art and more mathematics than the minimum required for college entrance.

Courses in design, including architecture and drawing, as well as landscape design, constitute over half of the typical curriculum in landscape architecture. Other major fields of study are civil engineering and horticulture. In addition, courses in English, science, the social sciences and mathematics usually are required. A bachelor's degree in landscape architecture provides a good background for graduate work in city planning.

Young people who plan to become landscape architects should be interested in both art and nature, for the profession demands a talent for design and an understanding of plant life, as well as technical ability. Successful practic' as an independent landscape architect also requires a good business sense and the ability to deal with people.

Women represent between 10 and 15 percent of all landscape architects. Well-trained and competent women landscape architects can look forward to interesting and worthwhile careers in the profession.

For students interested in teaching, jobs are becoming available due to more and more trade, secondary and post-secondary schools offering courses in landscaping and horticulture. These courses for the most part will be taught by people with advanced training in these fields.

GLOSSARY
LANDSCAPING

Acid, soil—a soil high in acid content with a low pH reading, below 7.

Alkaline soil—a soil high in alkaline materials (such as lime) with a high pH reading, above 7.

Annual—a plant which completes its life cycle in one year.

Anther—the pollen-bearing part of a flower.

B and B—an abbreviation for ball and burlapping of plants.

Cambium—a layer of growth just under the bark in woody plants. It is very important to the plant since this layer transports food.

Chlorosis—a condition in plants characterized by green veins and a yellowish leaf surface. Iron deficiency will cause this condition.

Conifer—an evergreen family which is cone-bearing and is characterized by needle-shaped leaves.

Deciduous—a term applied to plants which lose their leaves in winter.

Design—in landscaping, design has reference to making a careful study of a site in order to create the most pleasing, harmonious combination of natural surroundings and man's needed structures without sacrificing convenience or beauty.

Dioecious—species which have male organs and female organs on separate plants; opposite of monoecious.

Dormant—the period during which a plant makes no active growth.

Espalier—a technique used to train plants to grow in specific ways, such as up a wall or trellis.

Fertilization—(1) the application of fertilizer. (2) the transfer of pollen from an anther to a stigma.

Flat—a shallow container used to germinate seeds, grow cuttings or transport flowers.

Force—to cause a plant to grow or bloom earlier than normal.

Genus—a biological category which ranks between family and species.

Germinate—to sprout or begin to grow.

Grafting—a technique of inserting a shoot into a prepared slit in a plant or tree in such a way that the shoot becomes a living part of the receiving plant.

Grass – botanically, any plant of the family gramineae. Usually the plant has a fibrous root system and the leaf, called a blade, exhibits parallel veins.

Harden off – to gradually expose to more difficult growing conditions, such as cold or dry air.

Harmony – a term which, in landscape design, usually refers to consistency.

Hardy – in reference to plants, hardy usually denotes an ability to withstand Winter without protection.

Heeling in – a temporary storage of plants in a trench while awaiting transplanting.

Layering – a technique of plant propagation whereby part of a living plant is placed in soil for rooting.

Monoecious – those varieties of plants which have both male and female flowers on the same plant but in separate locations; opposite of dioecious.

Nutrients – elements needed by plants for healthy growth.

N-P-K – symbols for nitrogen, phosphorus and potash. They are found in this order on most commercial fertilizer containers.

Ovary – a portion of the base of the pistil which contains ovules which develop into seeds.

Perennial – a plant that lives more than two years.

Perfect flower – one with male and female flower parts in the same bloom.

pH – a symbol representing acidity or alkalinity on a scale ranging from 1-14; 7 is neutral, below 7 is acid and above 7 is alkaline.

Pistil – the pollen-receiving part of a flower.

Pollen – the male reproductive cells which, when applied to the pistil, begin the process of seed production.

Pollination – the process of transferring pollen from the anther to the stigma of a flower.

Propagation – the increase or multiplication of plants by cuttings, layering, etc.

Rhizome – a thick root stem such as found in the iris plant.

Scarification – a method of scratching hard-coated seeds to hasten germination.

Scion – in grafting or budding, a term given to the bud or cutting to be inserted into the stock or rooted plant.

Species—the biological classification immediately subordinate to a genus.

Stamen—the male organ of a flower.

Stigma—the part of a pistil which receives pollen during pollination.

Tender—a term applied to plants which cannot withstand cold for long periods of time.

Unity—in landscape design, the term "unity" is applied to tying together various components of the site.

APPENDIX

LANDSCAPING

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Careers as a Landscape Architect and Landscape Nurseryman, Institute for Research, 537 S. Dearborn St., Chicago, Ill. 60605.

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ABSTRACT: THE PURPOSE OF THIS INSTRUCTOR'S GUIDE IS TO OUTLINE A SERIES OF TRAINING EXPERIENCES RELATED TO ENGINEERING, SUPPORT AND MANAGEMENT SERVICES OCCUPATIONS THAT CAN LEAD A STUDENT TO AT LEAST ENTRY-LEVEL JOB PROFICIENCY. THE GUIDE IS DIVIDED INTO SEVERAL TEACHING UNITS, EACH WITH AN OVERALL OBJECTIVE. THERE ARE FURTHER DIVISIONS LISTING SUBOBJECTIVES WHICH, WHEN SUCCESSFULLY COMPLETED BY THE STUDENT, WILL SATISFY THE OVERALL OBJECTIVE FOR A SPECIFIC UNIT. SUGGESTED ACTIVITIES ARE LISTED UNDER THE SUBOBJECTIVES AND ARE SUPPORTED BY A NUMBER OF TEXTS. SOURCES OF INFORMATION AND AN OUTLINE OF "ACADEMIC RELATED THEORY AND INFORMATION" ARE ALSO INCLUDED IN EACH UNIT. UNIT TITLES FOR THIS GUIDE ARE: CONSTRUCTION DRAFTING, ARCHITECTURAL DRAWING, ENGINEERING DRAFTING, ESTIMATING, EXPEDITING AND SCHEDULING, SURVEYING, TESTING AND INSPECTING, MATERIAL DISTRIBUTION, AND BLUEPRINT READING. APPENDED IS A SAMPLE LESSON PLAN. THIS DOCUMENT SHOULD BE USED IN CONJUNCTION WITH THE STUDENT MANUAL FOR ENGINEERING, SUPPORT AND MANAGEMENT SERVICES (VT 102 412 IN THIS ISSUE). (AUTHOR/LJ)

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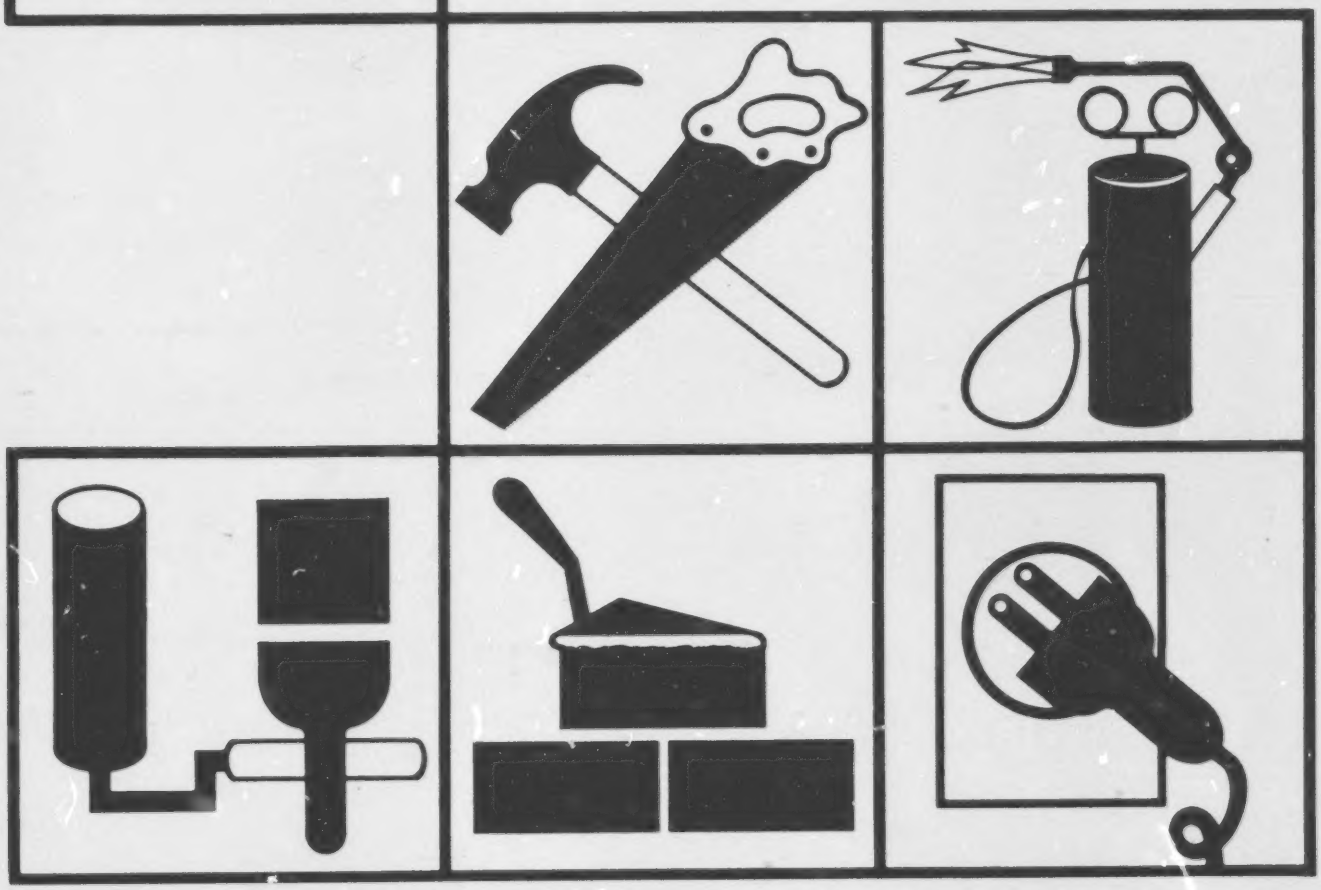

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This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

EXPLORATION LEVEL:

Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

OCCUPATIONAL PREPARATION LEVEL:

Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
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Metal - Instructor's Guide
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INTRODUCTION TO ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

OCCUPATIONAL PREPARATION

PURPOSE

The purpose of this guide is to outline a series of training experiences that can lead a student to at least entry-level job proficiency. The instructor guide is divided into several teaching units, each with an overall objective. There are further subdivisions listed as sub objectives which will satisfy the overall objective for a specific unit when successfully completed by the student. Suggested activities are listed under the sub objective and are supported by a number of texts.

Use of behavioral objective format may or may not be new to you. There are a few basic components which acceptable behavioral objectives must include. First, all behavioral objectives must be directed toward student performance. Second, they must clearly state action or behavior which a student must perform. Third, there must be some criteria by which you can measure the success or failure of that action or behavior.

The establishment of a series of measurable goals for each student can individualize the education and training process. If a student can demonstrate skill in certain basic tasks to the satisfaction of the instructor, the student can move on to tasks which are more challenging. Instructing all of your students in the performance of a task, in which many of them are already proficient, can severely affect enthusiasm and motivation. This problem can, in large part, be overcome by the use of a pretest designed to provide a beginning point from which the student can start his or her training. The systematic use of planned instructional outcomes (behavioral objectives) can serve to more effectively motivate students.

The instructor's guide makes no attempt to set down absolute standards defining successful student performance. It will be your responsibility to establish these performance levels for your students. Some performance standards, such as working safety, should probably be set at the 100 percent level. Your professional judgment, and the abilities of your individual students, provide the basis for determining the standard which students must meet before proceeding to another task objective.

PROGRAM APPROACH AND TECHNIQUE

During the exploratory phase of the Construction Program, students are encouraged to explore several job families in construction. As they enter your class, they have made a more refined choice and should now be prepared to develop a number of specific skills.

To accomplish the purpose of this program a two-fold approach has been taken. The material has been organized into two distinct components -- Instructor's Guide and Student Resource Manuals.

The Instructor's Guide is organized into a task-by-task outlining of suggested activities structured around behavorial objectives.

LESSON PLANNING

Organization and planning are essential to the success of any program. The four-step lesson plan recommended procedure is:

Step 1 Preparation of the Lesson. Applying the principle of Readiness, the instructor should prepare students for the lesson. Information sheets, reading assignments in the text and Student Resource Manual and other introductory techniques can help to prepare the student.

Step 2 Presentation. Applying the principle of Effect, the instructor should present and demonstrate a given process or activity supported by media and selected student involvement. Tell and show how to do the task step-by-step, citing critical check points and special safety requirements.

Step 3 Application of student performance. Applying the principle of Practice, the instructor should permit the students to do the assigned task. Special work sheets, drawings and instructions should be provided the student when necessary.

Step 4 Performance test. Applying the principle of Criteria, referenced testing is used to determine student performance at acceptable levels. Those students who do not meet acceptable performance standards are cycled through Steps 2, 3 and 4 again.

(See Appendix, Sample Lesson Plan)

STUDENT RESOURCE MANUAL

The Student Resource Manual is intended to serve as a supplemental text and information manual. It is designed and written for student use and it is structured to compliment the Instructor's Guide. Subjects such as tools and equipment, materials, processes and safety are discussed. A glossary of terms is included in each student manual.

The success or failure of a preparation program can depend on many things. It is hoped that you will encourage student participation in youth organizations which promote scholarship and craftsmanship. VICA organizations have been very successful in motivating and recognizing student accomplishments. If your school does not have a VICA chapter, you can be instrumental in starting one. The rewards to the community, school, and especially the student, can be readily apparent. Other student organizations, such as DECA, may be of interest to students aiming for careers in the wholesaling and retailing of construction products.

Of further value to your program would be the establishment and maintenance of a strong advisory committee. The involvement of members of the community can help to promote your program. A committee of this kind can form a solid bridge between school and community. If your school does not have a construction advisory committee, it is time to start one. The exchange of ideas can benefit both the school and community.

CONSTRUCTION DRAFTING

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to care for and use classroom drafting equipment.

SOURCES OF INFORMATION

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ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measurements
  - Whole numbers
  - Decimals
  - Fractions
- Ratios and proportions
- Degrees and angles

Communication Skills

- Lettering practice
- Student Resource Manual
- Manufacturer's literature
- Vocabulary development

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Case Instruments

SUB OBJECTIVE I: The student will demonstrate ability to care for and use, properly, classroom case instruments.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the care and use of various case instruments. Demonstration will include:

   A. Use of proportional dividers.
   B. Use of bow compass with pencil and ink and beam compass.
   C. Use of dividers.
   D. Use of center tacks.
   E. Use of stander pens, contour pens and border pens.
   F. Use of railroads.

II. Students familiarize themselves with care and use of case instruments.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Drafting Equipment

SUB OBJECTIVE 2: The student will demonstrate ability to use and care for equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates care for and use of equipment. Demonstration will include:

A. Drawing board.
B. T-square.
C. Parallel rule.
D. Drafting machine.
E. Triangles; include 30°-60°, 45° and lettering.
F. Scales; include flat and triangular engineer's and architect's rules.
G. French curve and irregular curve.
H. Protractor.
I. Cleaning brush.

II. Students use and care for drafting equipment.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Preparing the Sheets

SUB OBJECTIVE 3: The student will demonstrate ability to select and layout paper sizes, draw in margins and prepare a title block.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate cutting standard paper sizes from Vellum. Demonstration will include:

   A. Rough cut sizes; include 9 x 12, 12 x 18, 18 x 24, 24 x 36 and 36 x 48.
   B. Trim sizes; include 8-1/2 x 11, 11 x 17, 17 x 22, 22 x 34 and 34 x 44.
   C. Margin sizes.
   D. Drawing title block; include job title, school name, drawn by, checked by, date, sheet number and number of sheets, drawing size, code identification number and scale.

II. Students cut paper sizes.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Pencils

SUB OBJECTIVE 4: The student will demonstrate ability to select drawing pencil for specified tasks.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates selecting drawing pencil for a specific task.

A. Pencils used for art work.
1. 6B (softest and blackest)
2. 5B (extremely soft)
3. 4B (extra soft)
4. 3B (very soft)
5. 2B (soft plus)
6. B (soft)

B. Pencils used for tracing.
1. HB (medium soft)
2. F (intermediate)
3. H (medium hard)

C. Pencils used for lettering.
1. H (medium hard)
2. F (intermediate)
3. 3H (hard plus)

D. Pencils used for layout work.
1. 4H (very hard)
2. 5H (extra hard)
3. 6H (extra hard, plus)

E. Pencils used for graphical work.
1. 6H (extra hard, plus)
2. 7H (extremely hard)
3. 8H (extremely hard, plus)
4. 9H (hardest)

F. Demonstrate making correct pencil point shapes; include conical, wedge and bevel (or chisel) types.

II. Students select drawing pencils.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to do lettering of standard types and to use with accuracy the alphabet of lines.

SOURCES OF INFORMATION

French and Svensen, Mechanical Drawing, Seventh Edition, (McGraw-Hill, Webster Division: 1221 Avenue of the Americas, New York, New York 10020), 1966.

Hoelscher, R. P., C. H. Springer and J. S. Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Lettering types and practice
- Vocabulary development
- Student Resource Manual

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Printing

SUB OBJECTIVE 5: The student will demonstrate ability to print a lettering sheet.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates lettering:

A. Types of guides, such as horizontal guide lines, Ames lettering guides and Braddock-Rowe triangles.
B. Line sizes used on a printing sheet. (They are 1/4", 3/16", 1/8", 3/32" with at least 1/8" spacing between lines.)
C. Hand lettering using capital letters. Display styles of lettering (vertical and inclined), the strokes, the spacing and the required uniformity.
D. Mechanical lettering devices such as Leroy, Wrico and Letterguide.
E. Transfer lettering, including rub-on and cut-out types.
F. Discuss sheet balance and title layout. Demonstrate drawing border lines, trim lines and block and strip titles.

II. Students practice lettering.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Alphabet of Lines

SUB OBJECTIVE 6: The student will demonstrate ability to draw the alphabet of lines.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing various lines.

A. Drawing the different types of lines (in pencil); include border line (extra thick), visible line (line thick), hidden line (medium dashed), section line (thin), center line (long thin dashed line), extension line (dimension lines), dimension line (thin lines to extension), cutting-plane line (thick dashes), break lines (thick for short breaks), break lines (long thin) and guidelines line (thin).

B. Drawing same types of lines (in ink) as were shown for pencil.

II. Students draw the different lines in pencil and ink.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to perform basic freehand sketching operations.

SOURCES OF INFORMATION

French and Svensen, Mechanical Drawing, Seventh Edition, (McGraw-Hill, Webster Division: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Hoelscher, R. P., C. H. Springer and J. S. Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Arcs and circles
- Rectangles
- Triangles
- Scale measurements

Communication Skills

- Freehand sketching
- Blueprint reading

CONTENT TITLE: Freehand Sketches

SUB OBJECTIVE 7: The student will demonstrate ability to make freehand sketches.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates making freehand sketches and construction of:

A. 3" line, 1/4" apart in a 3 x 3 square box.
B. Square box and fill with 45° lines 1/4" apart.
C. A circle in 3" box and a 1" box.
D. An ellipse circle in a rectangle.
E. Arcs and concentric circles.

II. Students make freehand sketches.

CONTENT TITLE: Auxiliary Views

SUB OBJECTIVE 8: The student will demonstrate ability to sketch an auxiliary view.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates constructing an auxiliary view.

A. Construct a plane parallel to the inclined plane, (reference plane).
B. Construct lines perpendicular to inclined plane.
C. Construct reference plane on existing top or front view of the orthographic projection.
D. Sketch object using reference plane to obtain measurements.
E. Complete auxiliary view.

II. Students sketch an auxiliary view.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Three View Freehand Sketches

SUB OBJECTIVE 9: The student will demonstrate ability to make a three view freehand sketch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates making a freehand sketch.

   A. Construct an orthographic projection box.
   B. Demonstrate projection using a glass box.

II. Instructor demonstrates constructing a three view sketch.

   A. Sketch off distances, in three views.
   B. Block in views with light, thin lines.
   C. Sketch principal measurements.
   D. Sketch in details.
   E. Sketch in principal lines.
   F. Sketch in measurements for details.
   G. Sketch in circles and arcs.
   H. Brighten lines in views.

III. Students sketch a three view drawing.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Freehand Isometric Sketches

SUB OBJECTIVE 10: The student will demonstrate ability to make a freehand isometric sketch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates a freehand construction of a Z in isometric box.

- A. Sketch 30° axes, both right and left.
- B. Sketch off distance, weight, width and depth.
- C. Block in views with light, thin lines.
- D. Sketch principal measurement.
- E. Sketch in details.
- F. Sketch in principal lines.
- G. Sketch in measurements for details.
- H. Sketch in circles and arcs.
- I. Brighten lines in view.

II. Instructor demonstrates sketching a freehand isometric circle.

- A. Construct center line at 30° to right and left in center of page.
- B. Construct 1" on each side of center line in all four directions.
- C. Draw 30° light construction lines through these points.
- D. Label all corners, counting clockwise, starting at bottom of page.
- E. Construct dashed lines from 3 to 7; this ties the two longest points together.
- F. Construct lines from 2 to 5 and 1 to 6. These will cross the dashed lines and become points A and B.
- G. Construct small circles on point A and B.
- H. Construct large circles using point 4 and 2.

III. Students make freehand sketches.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to lay out objects using geometric construction.

SOURCES OF INFORMATION

French and Svensen, Mechanical Drawing, Seventh Edition, (McGraw-Hill, Webster Division: 1221 Avenue of the Americas, New York, New York 10020), 1966.

Hoelscher, R. P., C. H. Springer and J. S. Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Basic geometry
- Scale measurements

CONTENT TITLE: Line Constructions

SUB OBJECTIVE 11: The student will demonstrate ability to draw line constructions.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing basic geometric constructions. Demonstration will include:

A. Drawing a straight line between two points.
B. Drawing line parallel to another line, through a given point, by the compass method and the triangle method.
C. Bisecting a straight line by the compass and triangle methods.
D. Drawing line perpendicular to a given line by the compass method, the triangle method and with a scale.
E. Dividing a line into a given number of equal parts.

II. Students draw basic geometrical constructions.

CONTENT TITLE: Angle Constructions

SUB OBJECTIVE 12: The student will demonstrate ability to draw angle constructions.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate geometric construction of angles.

A. Construct a given angle with a protractor.
B. Construct an angle to a new position.
C. Bisect an angle.
D. Lay out an angle by the tangent method.
E. Divide an angle into equal parts.

II. Students draw angles using geometric construction.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Triangles

SUB OBJECTIVE 13: The student will demonstrate ability to draw line construction of triangles.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the geometric construction of triangles. Construction will include:

   A. A triangle with three sides given.
   B. An isosceles triangle.
   C. An equilateral triangle.
   D. A triangle with two angles and the side between them.

II. Students draw triangles using geometric construction.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Polygons

SUB OBJECTIVE 14: The student will demonstrate ability to draw quadrilateral and polygon constructions.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing quadrilateral and polygon constructions. Constructions will include:

A. A square drawn about a circle.
B. A square with length of diagonal given.
C. A pentagon within a given circle.
D. A hexagon within a given circle.
E. A hexagon with distance across corners given.
F. A hexagon with distance across flats given.
G. A polygon within a given circle.
H. A polygon with length of side given.
I. An octagon within a given circle.
J. An octagon with distance across corners given.

II. Students draw quadrilateral and polygon constructions.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Circles

SUB OBJECTIVE 15: The student will demonstrate ability to construct circles.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates geometric construction using circles. Geometric constructions will include:

A. A circle through any three points, not in a straight line.
B. A circle tangent to a given point on a straight line.
C. A circle tangent to two given straight lines.
D. A circular arc tangent to two other circles.
E. An interior common tangent to two circles of unequal radii.
F. An exterior common tangent to two circles of unequal radii.
G. An exterior common tangent to an arc tangent to two lines.
H. An arc in a right angle.

II. Student draws circles.

CONTENT TITLE: Tangent Circles

SUB OBJECTIVE 16: The student will demonstrate ability to draw a circle tangent to an arc.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a circle tangent to an arc.

A. Construct an arc tangent to two arcs.
B. Construct a circle tangent to two arcs.
C. Construct a reverse curve tangent to two arcs.

II. Student draws a circle tangent to an arc.

CONTENT TITLE: Ellipses

SUB OBJECTIVE 17: The student will demonstrate ability to construct an ellipse.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing an ellipse. Drawings will include:

A. An ellipse using the focii.
B. An ellipse using two circles.
C. An ellipse using diagonal method.
D. An ellipse by four center approximate, major and minor.
E. An ellipse using a template.
F. An ellipse using the tramel method.
G. An ellipse using isometric construction layout.

II. Students draw an ellipse.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to draw orthographic and pictorial drawings.

SOURCES OF INFORMATION

French and Svensen, Mechanical Drawing, Seventh Edition, (McGraw-Hill, Webster Division: 1221 Avenue of the Americas, New York, New York 10020), 1966.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Vocabulary development
- Isometric drawings
- Symbol interpretation
- Student Resource Manual

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Orthographic Drawing

SUB OBJECTIVE 18: The student will demonstrate ability to lay out and prepare orthographic drawings.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out an orthographic drawing.

A. Lay out vertical plane.
B. Lay out horizontal plane.
C. Lay out profile right.
D. Lay out profile left.
E. Select primary views from top, front, right, bottom, left and rear views.
F. Demonstrate projecting line of surface in orthographic drawing, (45° method and revolved method). Include construction of points, lines, curved lines, plane surfaces, lines of curved surfaces, curved surfaces, surfaces parallel to the planes of projection, inclined planes or oblique surfaces and hidden and center lines.
G. Demonstrate dimensioning the drawing. Include extension lines, distance, width, height and depth indicators, center lines, arrow heads, dimension figures, finish marks, notes and dimension lines.

II. Students draw and lay out orthographic drawings.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Auxiliary Views

SUB OBJECTIVE 19: The student will demonstrate ability to draw auxiliary view.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing an auxiliary view.

A. Draw reference plane.
B. Draw perpendicular lines.
C. Draw reference plane, (existing view).
D. Transfer measurements.
E. Dimension object.

II. Students draw an auxiliary view.

CONTENT TITLE: Isometric Drawings

SUB OBJECTIVE 20: The student will demonstrate ability to construct isometric drawings.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing isometric drawings.

A. Select layout for isometric axis.
B. Construct projection lines; include demonstrations of constructing isometric lines, non-isometric lines and dimension lines.
C. Demonstrate constructing isometric circles and cylindrical objects.
D. Demonstrate constructing isometric sections.
E. Demonstrate constructing isometric dimensions.

II. Students prepare isometric drawings.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Oblique Drawings

SUB OBJECTIVE 21: The student will demonstrate ability to construct oblique drawings.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing oblique drawings.

A. Construct oblique layout and oblique axis.
B. Demonstrate constructing oblique lines and non-oblique lines.
C. Demonstrate constructing circles and cylindrical objects.
D. Demonstrate constructing oblique sections.
E. Demonstrate constructing oblique dimensioning.

II. Students make oblique drawings.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Special Dimensions

SUB OBJECTIVE 22: The student will demonstrate ability to draw special dimensions.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate and construct special dimensions. Constructions will include:

A. Size and location dimensions.
B. Dimensions for circles and arc.
C. Dimensions by note.
D. Dimensions by angles.
E. Dimensions for chamfer.
F. Dimensions for counterbore.
G. Dimensions for drill and countersink.
H. Dimensions for taper.
I. Dimensions for keyway.
J. Dimensions for pipe threads.
K. Dimensions for showing size and number of holes.
L. Dimensions showing operation and size.
M. Dimensions showing hole all the way through.

II. Students draw special dimensions.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Sections

SUB OBJECTIVE 23: The student will demonstrate ability to draw sections.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing sections.

A. Demonstrate drawing orthographic sections. Include full, half, broken out, revolved, removed, section symbols, offset, pictorial, phantom and auxiliary section.

B. Demonstrate drawing isometric sections. Include full, half, broken out, revolved, removed, section symbols, offset, pictorial, phantom and auxiliary section.

C. Demonstrate drawing oblique sections. Include full, half, broken out, revolved, removed, section symbols, offset, pictorial, phantom and auxiliary section.

II. Students draw sections.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to draw a detailed representation of nuts, bolts and screw threads and types.

SOURCES OF INFORMATION

French and Svensen, Mechanical Drawing, Seventh Edition, (McGraw-Hill, Webster Division: 1221 Avenue of the Americas, New York, New York 10020), 1966.

Hoelscher, R. P., C. H. Springer and J. S. Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 19[illegible].

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Vocabulary development
- Student Resource Manual
- Technical literature

CONTENT TITLE: Screw Threads

SUB OBJECTIVE 24: The student will demonstrate ability to draw various screw thread profiles.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing various types of screw pipes. Drawings will include:

A. American National (coarse and fine).
B. B & S worm thread.
C. Dardelet.
D. Sharp "V".
E. Acme.
F. British Standard (Whiteworth).
G. Square
H. Knuckles.
I. Buttress.

II. Students draw various screw thread profiles.

CONTENT TITLE: Nuts and Bolts

SUB OBJECTIVE 25: The student will demonstrate ability to draw a bolt, washer and nut.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a bolt, washer and nut. Drawings will include:

A. Bolt head (hexagon).
B. Body.
C. Threads (external threads).
D. Washer (nut-locking devices).
E. Nut (hexagon with internal threads).

II. Students draw bolts, washers and nuts.

CONTENT TITLE: Locking Keys

SUB OBJECTIVE 26: The student will demonstrate ability to draw locking key types.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing locking keys. Drawings will include:

A. A detail of key and keyway (plain key).
B. A spline key.
C. A saddle key.
D. A flat key.
E. A round key.
F. Lewis key.
G. Woodruff key.

II. Students draw locking key types.

CONTENT TITLE: Screws

SUB OBJECTIVE 27: The student will demonstrate ability to draw screw types.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing screw types. Drawings will include:

A. Wood screw.
B. Lag screw.
C. Screw hooks; include straight, round and bent hooks.
D. Cap screws; include hexagonal, fillister, flat, button, fluted socket and hexagonal socket screws.
E. Machine screws; include flat, oval, round, fillister, truss, binding and pan types.
F. A set screw base; include flat point, cup, oval, flat, cone, full dog and half dog types.

II. Students draw set screws.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Bolts

SUB OBJECTIVE 28: The student will demonstrate ability to draw bolt types.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing bolt types. Drawings will include:

   A. Stud bolts with square head bolt, nut, hex head bolt and nut.
   B. Hanger bolts.
   C. Stove bolts.
   D. Carriage bolt.
   E. Eye bolt.
   F. Toggle bolt.
   G. Table bolt and wing nut.
   H. Turnbuckles.
   I. Stud bolt.

II. Students draw bolt types.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Nuts

SUB OBJECTIVE 29: The student will demonstrate ability to draw standard nut types.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing standard nut types. Drawings will include:

A. Square nut.
B. Track bolt nut.
C. Machine screw nut.
D. Hexagon JAN nut.
E. Hexagon thick nut.
F. Hexagon slotted nut.
G. Hexagon thick slotted nut.
H. Hexagon castle nut.
I. Cap (acorn) nut.

II. Students draw standard nut types.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to draw and develop patterns.

SOURCES OF INFORMATION

French and Svensen, Mechanical Drawing, Seventh Edition, (McGraw-Hill, Webster Division: 1221 Avenue of the Americas, New York, New York 10020), 1966.

ACADEMIC RELATED THEORY AND INFORMATION

Math

Review math requirements for engineering drafting and/or architectural drawing.

Communication Skills

Review communication skills requirements for engineering drafting and/or architectural drawing. Students interested in technical or professional careers in construction should select either engineering drafting or architectural drawing for additional training and experience.

CONTENT TITLE: Package Design

SUB OBJECTIVE 30: The student will demonstrate ability to draw and develop a pattern for a package.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses packages.

A. Discuss contents of package and their influence on package design.
B. Discuss package materials.

II. Instructor demonstrates developing a package design.

A. Construct pattern for drawing.
B. Construct stretchout line for measuring.
C. Label parts; include inside of package, top of floor, top of roof, cut lines and fold lines.
D. Construct an auxiliary view.
E. Construct tab; indicate welding and gluing.

III. Students develop a pattern for a package.

CONTENT TITLE: Package Patterns

SUB OBJECTIVE 31: The student will demonstrate ability to draw and develop patterns.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates developing patterns for various shaped objects. Use parallel lines, radial lines, triangulation and elementary intersection methods. Patterns will include:

A. A cube.
B. A prism.
C. A cylinder.
D. A truncated cylinder.
E. A four piece elbow.
F. A rectangular pyramid.
G. A cone.
H. A transition piece.
I. Intersecting cylinders.
J. An intersecting prism.

II. Students develop patterns for various shaped objects.

ARCHITECTURAL DRAWING

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to lay out and arrange a typical printing sheet.

SOURCES OF INFORMATION

Weidhaas, Ernest R., Architectural Drafting and Design, (Allyn Bacon, Inc.: Rockleigh, New Jersey 07647), 1968.

Wyatt, William E., General Architectural Drawing, (Charles A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
  - Spacing and layout

Communication Skills

Lettering

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Layout and Lettering

SUB OBJECTIVE 1: The student will demonstrate ability to layout paper sizes.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate the preparation of a standard sized drawing and will discuss the need to keep drawings standardized.

   A. Outline standard drawing sizes (8-1/2 x 11, 18 x 24 and 24 x 36).
   B. Discuss trim lines.
   C. Discuss margin sizes.

II. Students draw a standard size sheet.

CONTENT TITLE: Layout and Lettering

SUB OBJECTIVE 2: The student will demonstrate ability to draw a title block.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a title block.

   A. Draw block 1-3/4" x 4" or other standard size.
   B. Demonstrate the spacing used in printing for sentences or special notes.
   C. Demonstrate the use of vertical and slant type lettering in preparing a working drawing.
   D. List information needed; i.e., type of building, client's name and address, initials of draftsmen, initials of draftsman who traced the drawing, initials of checker, date job is finished, job number, sheet number and number of sheets in job.

II. Students draw a title block.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Layout and Lettering

SUB OBJECTIVE 3: The student will demonstrate ability to letter drawings.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate using vertical capital letters.

   A. Demonstrate spacing of different types.
   B. Demonstrate vertical and slant type.
   C. Discuss arrangement and balance.
   D. Discuss whole numbers and fractions.

II. Instructor demonstrates using a lettering plate, size 18 x 24.

III. Students do an 18 x 24 lettering plate, title block and margin using vertical capital letters.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to develop, lay out and draw a detailed bathroom.

SOURCES OF INFORMATION

Hepler, Donald E. and Paul I. Wallach, Architecture Drafting and Design, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Sweet's Catalog (Light Construction File), (Sweet's Catalog Service, F. W. Dodge Company, Division of McGraw-Hill Book Company: 1221 Avenue of the Americas, New York, New York 10020).

Weidhaas, Ernest R., Architectural Drafting and Design, (Allyn Bacon, Inc.: Rockleigh, New Jersey 07647), 1968.

Wyatt, William E., General Architectural Drawing, (Charles A. Bennett Co., Inc.: 809 West Detweiller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Scale
  - Whole numbers
  - Fractions
  - Decimals

Communication Skills

Blueprint interpretation

Symbols

46

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Bath Plans

SUB OBJECTIVE 4: The student will demonstrate ability to design and layout a bath plan and to draw the basic types of medicine cabinets and exhaust fans.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates layout of the bathroom. Drawings of layout will include:

A. Proper size and shape of room such as 5'6" x 8'
B. Linen closet (4' x 6'8") with storage facilities and clothes hamper.
C. Fixtures, including medicine cabinet and combination exhaust fan.
D. Electrical plans showing location of switches and convenience outlets.

II. Students design and layout a bathroom.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Bath Plans

SUB OBJECTIVE 5: The student will demonstrate ability to lay out plumbing.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate drawing the various types of plumbing fixtures.

   A. Demonstrate drawing plumbing fixtures; include symbols for: Standard tub, corner tub, shower, water closet, wall hung (w.c.), lavatory, oval lavatory, double sink, water heater and shower head.
   B. Demonstrate drawing heating fixtures; include symbols for: Combination exhaust fan, instant wall heater, gas heater and sunlamp.
   C. Demonstrate drawing ventilation fixtures; include symbols for: w/c, vent pipe, lavatory vent pipe.
   D. Demonstrate drawing water supply fixtures; include symbols for: Hot water and cold water.
   E. Discuss fixture ventilation requirements, plumbing hardware and drawing hot and cold water lines.

II. Students draw the various types of plumbing symbols.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Bath Plans

SUB OBJECTIVE 6: The student will demonstrate ability to draw the various types of wall covering.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate drawing the various types of wall coverings. These should include plaster, a variety of tiles, plastic-covered wallpaper, corrugated plastic sheets, wood paneling, marble, terrazzo, glass, mirror panels and mosaic tile.

II. Students practice drawing the various types of wall coverings such as plaster, tile, plastic-covered wallpaper, corrugated plastic sheets, wood paneling, marble, terrazzo, glass, mirror panels and mosaic tile.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to develop, lay out and draw a detailed kitchen.

SOURCES OF INFORMATION

Hepler, Donald E. and Paul I. Wallach, Architecture Drafting and Design, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Sweet's Catalog (Light Construction File), (Sweet's Catalog Service, F. W. Dodge Company, Division of McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020).

Weidhaas, Ernest R., Architectural Drafting and Design, (Allyn Bacon, Inc.: Rockleigh, New Jersey 07647), 1968.

Wyatt, William E., General Architectural Drawing, (Charles A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring and layout
- Scale

Communication Skills

- Blueprint interpretation
- Symbols

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Kitchens

SUB OBJECTIVE 7: The student will demonstrate ability to design and layout a kitchen plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out a kitchen plan.

A. Draw cabinet frontage.
B. Indicate required distance between sink and range.
C. Indicate required distance between sink and refrigerator.
D. Indicate maximum acceptable distance from range to refrigerator.

II. Instructor demonstrates laying out a plan and using symbols in their proper placement.

A. Sketch cabinet layout; mention typical width of bottom and top cabinets.
B. Sketch range top and indicate optimum oven placements; include oven hoods and ventilation facilities.
C. Sketch dish washer and sink; indicate standard optimum placements.
D. Allow refrigerator space.
E. Include a window over the sink.

III. Students draw a kitchen.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Kitchens

SUB OBJECTIVE 8: Given a description of the cabinet work, the student will demonstrate ability to draw a typical cabinet.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate drawing a typical cabinet section detail.

A. Draw floor line or foundation.
B. Draw wood blocking.
C. Draw toe space.
D. Draw base cabinet 35-1/2" high x 24" wide.
E. Use formica cabinet top.
F. Allow 1'6" working space between cabinets.
G. Allow 2'6" high x 12" wide top cabinet.
H. Include 1' x 1/2" gypsum board furring on ceiling.
I. Include 3/4 plywood doors.
J. Place shelves.

II. Students draw a typical cabinet section.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Kitchens

SUB OBJECTIVE 9: Given standard dimensions and samples to imitate, the student will demonstrate ability to draw interior kitchen elevations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing the four interior kitchen elevations.

   A. Use a scale.
   B. Use interior elevation symbols.
   C. Indicate elevation for all cabinet frontage.
   D. Select all built-in appliances.
   E. Allow refrigerator space.
   F. Use standardized cabinet and door sizes.
   G. Detail cabinet door design.
   H. Indicate direction of cabinet door swings.
   I. Indicate placing of window(s) over the sink.
   J. Dimension and add special notes.

II. Students draw interior kitchen elevations.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Kitchens

SUB OBJECTIVE 10: The student will demonstrate ability to draw electrical symbols on the elevation and plan view.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing electrical symbols on the elevation and plan views. Drawings will include symbols for:

A. Garbage disposal.
B. Range hood.
C. Range top.
D. Oven (electric or gas).
E. Refrigerator.
F. Light over sink.
G. Standard lights and switches.

II. Student adds electrical symbols on his elevations and plan view.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to detail framed walls, doors and windows.

SOURCES OF INFORMATION

Federal Housing Administration, Department of Housing and Urban Development, Minimum Property Standards for One and Two Living Units. (Order from GPO, Document No. HH2.17/4: 965).

Hepler, Donald E. and Paul I. Wallach, Architecture Drafting and Design, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Wyatt, William E., General Architectural Drawing, (Charles A. Bennett Co., Inc.: 809 Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Cost computation
- Material sizing
- Square and cubic feet measurements

Science

- Moisture proofing
- Uses of reinforcing in concrete

Communication Skills

- Symbols
- Vocabulary
- Material price lists

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Detailing Walls, Doors and Windows

SUB OBJECTIVE 11: The student will demonstrate ability to draw a door detail.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate drawing various types of doors. Drawings of doors will include:

   A. Exterior door.
   B. Interior Door.
   C. Solid core.
   D. Hollow core.
   E. Fiber core.
   F. Pocket core.
   G. Sliding closet unit.
   H. Accordian.
   I. Folding, lower closet unit.

II. Students draw a typical door detail.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Detailing Walls, Doors and Windows

SUB OBJECTIVE 12: The student will demonstrate ability to draw a window detail.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and illustrates window types, including casement, awning, hopper, projected, sliding, double hung, pivoted, jalousie, fixed and basement windows.

II. Instructor demonstrates drawing a typical window detail of a double hung window. Drawings will include:

A. Rough opening.
B. Head.
C. Jamb.
D. Sill and rail.

III. Students draw a typical double hung window.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Detailing Walls, Doors and Windows

SUB OBJECTIVE 13: The student will demonstrate ability to draw an L-shaped gable roof plan and detail and to identify the various standard roof shapes by name, prepare a bill of materials and calculate total cost of framing a house.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a roof detail. Roof detail will include:

   A. Plan.
   B. Elevation, including span, run and rise figures.
   C. Structure details.

II. Instructor describes the various types of roof shapes. Illustrate low gable roofs, continuous low gable roofs, L-shaped gable roofs, continuous steep gable roofs, low hip roofs, steep hip roofs, mansard roofs, "Dutch" hip roofs, shed roofs, flat roofs, butterfly roofs, folded plate roofs and curved panel roofs.

III. Student draws an L-shaped gable roof.

IV. Students draw a framing detail of an L-shaped roof with a 4 to 12 pitch. Include studs at 16" o.c., double plates, ceiling joists, rafters with framing anchors, blocking rafter ends, soffits, 2' continuous air vent in soffits, fascia, bargeboards, decking, gable studs or crippled studs, blocking gable rafter, ridgeboard, hip rafters, valleys (jack rafters), cripple rafters, collar beams, kick-blocks or knee braces, flashing, 15 pound felt paper and asphalt shingles.

CONTENT TITLE: Detailing Walls, Doors and Windows

SUB OBJECTIVE 14: The student will demonstrate ability to draw a wall framing detail.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the various types of wall construction.

A. Corner construction.
B. Intersection of partitions.
C. Window and door openings.
D. Type of dimensioning.

II. Student draws a wall frame detail.

CONTENT TITLE: Detailing Walls, Doors and Windows

SUB OBJECTIVE 15: The student will demonstrate ability to draw a typical wall section and produce a bill of materials for the section.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a typical wall section for a frame house.

A. Discuss and sketch a concrete foundation.
B. Discuss methods and sketch plans for wood framing.
C. Indicate symbology for asphalt shingles.

II. Student draws a typical wall section.

III. Students should draw all dimensions and notes that are to be shown in 3/32 letters.

IV. Students should produce a list of materials for the construction of an exterior wall.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to develop, lay out, label and dimension all four elevations.

SOURCES OF INFORMATION

Federal Housing Administration, Department of Housing and Urban Development, Minimum Property Standards for One and Two Living Units, (Order from GPO, #HH2.17/4: 965).

Hepler, Donald E. and Paul I. Wallach, Architecture Drafting and Design, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Wyatt, William E., General Architectural Drawing, (Charles A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Establishing grades and elevations
- Material and component sizing
- Scale measurements

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Elevations

SUB OBJECTIVE 16: The student will demonstrate ability to draw a set of detailed elevations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor illustrates drawing a complete detailed elevation including such items as steps, porches, columns, windows, exterior doors, corner boards, vertical or horizontal siding, brick or block, rafter ends, fascia, eave lines, soffits, gable ventilators (louver), roof dormers (cupolas) and roof lines.

II. Students draw a complete detailed elevation.

CONTENT TITLE: Elevations

SUB OBJECTIVE 17: The student will demonstrate ability to draw and label specifications for building materials.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate drawing and labeling specificatios for building materials. Specifications will include:

A. Type of roof covering (wood shingles, composition or rolled roofing).
B. Door details (design, size and type).
C. Special glass such as fixed glass or lowered glass.
D. Window type, size and design.
E. Garage door type, size and design.
F. Unique features such as brick flower boxes, wood shutters or gutters.

II. Instructor demonstrates drawing of special materials to be used as built-ins for the house elevation.

III. Students draw and label specifications for building materials.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Elevations

SUB OBJECTIVE 18: The student will demonstrate ability to dimension all four elevations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates dimensioning front elevations. Dimensioning will include:

   A. Ground line or grade line, floor line, ceiling line and ridge board.
   B. Roof pitch, 4 to 12.
   C. Height from ground to floor line.
   D. Height from ground to ceiling.
   E. Height from floor to bottom and top of windows.
   F. Height of various windows.
   G. Height of chimney above ridge board.

II. Students dimension front elevations.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to lay out and draw a material schedule.

SOURCES OF INFORMATION

Hepler, Donald E. and Paul I. Wallach, Architecture Drafting and Design, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Muller, Edward J., Architectural Drawing and Light Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1967.

Sweet's Catalog (Light Construction File), (Sweet's Catalog Service, F. W. Dodge Co., Division of McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020).

Weidhaas, Ernest R., Architectural Drafting and Design, (Allyn Bacon, Inc.: Rockleigh, New Jersey 07647), 1968.

Wyatt, William E., General Architectural Drawing, (Chas. A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Numbers as symbols
- Windows and door sizing

Communication Skills

- Manufacturer's literature
- Sweet's Catalog usage

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Schedules

SUB OBJECTIVE 19: The student will demonstrate ability to produce a door schedule.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a door schedule. Drawings will show:

A. That symbols used on floor plan are the same symbols used on the door schedule, (capital letters).
B. That the door width drawn on floor plan must be the same as shown under width on the schedule.
C. Door height and width.
D. Door thickness.
E. Type materials used on doors.
F. Type door used in drawing a house.
G. Quantity and type of screen doors.
H. Quantity of each type of door.
I. Type threshold used.
J. Wood finish remarks.
K. Introduce manufacturers of doors and introduce students to their products.

II. Students draw a door schedule.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Schedules

SUB OBJECTIVE 20: The student will demonstrate ability to produce a window schedule.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate drawing a window schedule.

A. Demonstrate that symbols used on floor plan are the same symbols used on the window schedule (numbers).
B. Demonstrate that the window width drawn on floor plan must be the same as shown under width on the schedule.
C. Demonstrate that the window height drawn on elevation must be the same as shown under height on the schedule.
D. Describe materials used on windows.
E. Describe types of windows used.
F. Describe the techniques of using window screens.
G. List quantity of each type used in house.
H. Demonstrate drawing remarks as to number of window lites and glass type.
I. Introduce manufacturers of windows and their products.
J. Demonstrate using Sweet's catalogs to find catalog numbers for windows.

II. Students draw a window schedule including the above.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will memorize and demonstrate ability to draw the conventional symbols for materials and details used in residential construction.

SOURCES OF INFORMATION

Hepler, Donald E. and Paul I. Wallach, Architecture Drafting and Design, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Muller, Edward J., Architectural Drawing and Light Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1967.

Weidhaas, Ernest R., Architectural Drafting and Design, (Allyn Bacon, Inc.: Rockleigh, New Jersey 07647), 1968.

Wyatt, William E., General Architectural Drawing, (Chas. A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Symbols and their uses
- Interpretation of blueprints

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Symbology

SUB OBJECTIVE 21: The student will demonstrate ability to draw building material symbols and symbol details.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing symbol details.

A. Demonstrate construction of architectural symbols in plans and elevations. Include: Wood, concrete, brick, stove, tile, gypsum, insulation, metal, earth, floor finishes, bath tubs, showers, water closets, urinals, drinking fountains, lavatories, sinks and built-ins.

B. Demonstrate drawing plumbing symbols. Include: Water heater, floor drain, hose bib, clean out, fresh air intake, sump pit, service sink and laundry tray.

C. Demonstrate drawing piping symbols. Include: Soil or waste, vent, cold water, hot water, acid water, sprinkler drain, vacuum cleaners and gas.

D. Demonstrate drawing ductwork symbols. Include: Duct size data (lst fig - width, 2nd fig - depth), direction of flow, rise or drop in duct, register, supply, grille, exhaust and lower opening.

E. Instructor will demonstrate drawing electrical symbols. Include: Ceiling outlets, blanket outlets, drop cards, junction boxes, pull switch-ceilings, bracket outlets, single pole light switches, double pole light switches, three-way light switches, pilot lights on light switches, key operated switches, waterproof switches, generators, motors, annunciators, floor outlets, fluorescent lights, lighting panels, duplex convenience outlets, convenience outlets - single and triplex, weatherproof convenience outlets, range outlets, switch and convenience outlets, radio and convenience outlets, clock outlets, push buttons, buzzers, bells, outside telephones, inter-connecting telephones, electric door openers, fire alarm stations, fire alarm bells, exhaust fans and air conditioning.

II. Students practice drawing symbols. Practice all symbols listed above.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to develop lay out and draw a plot plan.

SOURCES OF INFORMATION

Weidhaas, Ernest R., Architectural Drafting and Design, (Allyn Bacon, Inc.: Rockleigh, New Jersey 07647), 1968.

Wyatt, William E., General Architectural Drawing, (Chas. A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATiON

Math

- Linear measurement
- Square feet computations

Science

- Compass points
- Topography

Communication Skills

- Field note descriptions of property
- Building restrictions and codes
- Sample easements
- Special terminology and vocabulary

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Plots

SUB OBJECTIVE 22: Given a legal description, the student will demonstrate ability to draw the lot.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the need for a legal description.

II. Instructor demonstrates drawing a lot using a legal description.

A. Draw lot.
B. Add subdivision name, county and State.
C. Letter street and alley names.
D. Indicate true North, magnetic North and scale.
E. Include lot size and magnetic bearings.
F. Label easements and zoning regulations.
G. Add building setback (B_L).
H. Indicate distance from curb to property line (P_L).

III. Students draw a lot layout using legal descriptions.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Plots

SUB OBJECTIVE 23: The student will demonstrate ability to draw a house foundation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing house foundation plans. Plans will include:

A. Location of foundation on lot.
B. Building setback (restriction of location of building).
C. Finished floor elevation and grade at corners.
D. Garage floor elevation.
E. Location and elevation of accessory buildings if any.
F. Location and dimensions of drives, walks, patios, retaining walls, steps and fences.
G. Hidden lines used to indicate roof overhang.
H. Intersections of ridges, valleys and hips with hidden lines.

II. Student draws a house foundation.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Plots

SUB OBJECTIVE 24: The student will demonstrate ability to layout and draw contour lines of a plot.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate and draw contour lines.

A. Layout lot.
B. Contour intervals.
C. Draw contour line either dashed or solid.
D. Make lines over streams always point up-stream.
E. Change contour lines around foundation.
F. Draw original contour lines dashed, new or finished contours solid.
G. Contour slap 8" minimum above finished ground.
H. Indicate lot drainage flow.

II. Students draw contour lines.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Plots

SUB OBJECTIVE 25: Given a description of the location of utilities, the student will demonstrate ability to locate on the plot plan and draw utilities.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate drawing utilities. Drawings will include:

A. Curbs.
B. Storm sewer.
C. Sanitary sewer and invert elevation manhole.
D. Gas line.
E. Water lines.
F. Electric connection and poles.
G. Location of septic tank and seepage beds, if applicable.
H. Easements on property (rights to the property by someone other than the owners).
I. Location of nearby fire hydrant.

II. Students locate and draw all utilities.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Plots

SUB OBJECTIVE 26: The student will demonstrate ability to make the legend for a plot layout.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses function and arrangement of legends.

II. Instructor demonstrates drawing a legend. Legends will include:

A. Title drawing.
B. Symbol for existing contours.
C. Symbol for proposed contours.
D. Symbol for drainage flow.
E. Iron pins.
F. P.O.B. (point of beginning) of survey.
G. Property line symbols.
H. Building line symbols.
I. Utilities symbols.
J. Drawing scale.

III. Students draw a legend.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to draw a small frame house foundation, (slab and beam).

SOURCES OF INFORMATION

Hepler, Donald E. and Paul I. Wallach, Architecture Drafting and Design, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Muller, Edward J., Architectural Drawing and Light Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1967.

Weidhaas, Ernest R., Architectural Drafting and Design, (Allyn Bacon, Inc.: Rockleigh, New Jersey 07647), 1968.

Wyatt, William E., General Architectural Drawing, (Chas. A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review all math computations

Communication Skills

- Review lettering symbols and specifications

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Foundations

SUB OBJECTIVE 27: The student will demonstrate ability to draw a plan view of a foundation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the various types of foundation plans used in residential construction. Discussion will include:

   A. Wood pier and wood sill foundation.
   B. Concrete pier and wood sill foundation.
   C. Concrete beam and slab foundation.
   D. Aspects of locating foundation on building site.

II. Instructor demonstrates drawing a foundation plan. Drawing will include:

   A. Exterior wall outline (overall size).
   B. Interior and garage walls as required.
   C. All wall footing as construction lines.
   D. All doors, windows and their footing.
   E. Fireplace outline and its footing.
   F. Staircase outline and its footing.
   G. All drops and rises in slab.
   H. Waterproof membrane or vapor barrier.
   I. Minimum slab thickness.

III. Students draw a foundation plan.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Foundations

SUB OBJECTIVE 28: The student will demonstrate ability to lay out and draw foundation section drawings.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the application of foundation section drawings.

II. Instructor demonstrates drawing foundation sections. Foundation drawing will include:

A. Exterior house beam and slab section (section A-A).
B. Interior house beam and slab section (section B-B).
C. Beam and slab section taken between house and attached garage (section C-C).
D. Beam section taken between house and porch or steps (section D-D).
E. Exterior porch beam and slab (section E-E).
F. Exterior beam of garage and slab (section F-F).
G. Interior garage beam and slab (section G-G).
H. Ramp to garage door (section H-H).
I. Planting box slab (when applicable) and exterior house beam (section I-I).

III. Students draw foundation section.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Foundations

SUB OBJECTIVE 29: The student will demonstrate ability to print foundation specifications.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses need for and use of specifications.

II. Instructor demonstrates specification requirements. (Comply with these minimums.)

A. Strength: 2500 PSI minimum compressive strength.
B. Laps or Splices: Minimum 30 diameter.
C. Slab: 4" minimum thickness with #3 bars, 10" o.c. both ways. Maximum clearance of beam should be 15'.
D. Beams: 10" wide by 30" deep (24" deep for attached garage, carport or porch beams). Reinforce with two #6 bars top and two #8 bars bottom, continuous. Space all stirrups 22" o.c.; all beams shall penetrate a minimum of 6" into undisturbed soil.
E. Corner Bars: Provide #6 corner bars in all corners of the perimeter of exterior beams. Install one at top -- outside, and one at bottom -- outside.

III. Student prints all concrete specification requirements.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Foundations

SUB OBJECTIVE 30: The student will demonstrate ability to draw and specify the foundation beams.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses foundation beams.

II. Instructor demonstrates drawing the location and size of foundation beams.

A. Use 15' maximum spacing between beams.
B. Set exterior beams 30" deep minimum.
C. Set interior beams 24" deep minimum.
D. Set all beams a minimum of 6" into undisturbed soil.
E. Set all beams a minimum of 10" wide.
F. Draw slab a minimum of 4" thick.
G. Draw slab a minimum of 8" above ground line.

III. Student draws foundation beams.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TI[illegible] Foundations

SUB OBJECTIVE 31: Given a pre-existing drawing for a slab foundation, the student will locate and determine the steel size for the foundation; in addition, given the specifications for a slab, will draw the steel for that slab.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the size and location of steel used in a slab.

II. Instructor demonstrates preparing steel drawings to meet minimum specifications. Drawings will include:

A. Steel for exterior beam (two #6 bars, top and bottom) with a minimum of 1-1/2" coverage on the bottom, 1" coverage on both sides. Stirrups should be at least 22" o.c.
B. Steel for interior beam (two #6 bars, top and bottom).
C. Drop section between house and garage. Drop should be connected with #3 "Z" bar lapped 11".
D. Steel for slab. Steel should be 7" maximum from the beam, tied with #3 bar 10" o.c. both ways.
E. Steel for porches and patio, wire mesh.
F. Steel for garage ramp, 1/2" bars 12" o.c. Use 2-1/2" bars running the length of the ramp.

III. Students draw the steel for a slab.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to prepare presentation drawings and two-point perspective drawings of a house.

SOURCES OF INFORMATION

Hepler, Donald E. and Paul I. Wallach, Architecture Drafting and Design, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Muller, Edward J., Architectural Drawing and Light Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1967.

Weidhaas, Ernest R., Architectural Drafting and Design, (Allyn Bacon, Inc.: Rockleigh, New Jersey 07647), 1968.

Wyatt, William E., General Architectural Drawing, (Chas. A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Angles and degrees

Communication Skills

- Perspective drawings examination

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Presentations

SUB OBJECTIVE 32: The student will demonstrate ability to prepare a presentation drawing from a sketch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates translating a sketch into a definitely arranged and accurately drawn plan.

   A. Discuss application of presentation drawings.
   B. Emphasize that it is necessary to make quick accurate drawings to a small scale (1/4" = 1').
   C. Discuss methods of further perfecting the design, arrangement and room sizes of a floor plan.
   D. Emphasize the savings gained by using standard size doors and windows.
   E. Emphasize importance of knowing the size of house furnishings and equipment such as kitchen fixtures, bathroom fixtures, water heaters, air conditioning equipment and built-ins.
   F. Outline the dimensions that are necessary on a drawing of this type, using overall sizes.

II. Students make a presentation drawing.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Foundations

SUB OBJECTIVE 33: The student will demonstrate ability to produce a two-point perspective drawing of a house.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate how to make a two-point perspective of a house.

A. Discuss the advantages of using a perspective in selling a client on a particular house.
B. Locate plan view behind picture plane and horizontal line.
C. Locate drawing face at 30° and short side at 60°.
D. Set ground line.
E. Select elevation view on ground line.
F. Select station point with a max, cone of vision.
G. Find both vanishing points and locate with reference to station points.
H. Find vanishing point touching picture plane and project it down to ground line. Vanish drawing to vanishing points.
I. Draw sight lines from the station point to the corners of the plan view. The intersections of these sight lines and the picture plane are to find the extreme corner of the perspective view.
J. Complete details of the drawing.
K. Complete the perspective by projecting from the extreme corner to the vanishing points. The corners may be checked by projecting from the picture plane.
L. Remove invisible lines.

II. Student prepares a two-point perspective drawing.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to lay out, design and dimension a working floor plan.

SOURCES OF INFORMATION

Hepler, Donald E. and Paul I. Wallach, Architecture Drafting and Design, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Muller, Edward J., Architectural Drawing and Light Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1967.

Weidhaas, Ernest R., Architectural Drafting and Design, (Allyn Bacon, Inc.: Rockleigh, New Jersey 07647), 1968.

Wyatt, William E., General Architectural Drawing, (Chas. A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring and layout
- Material sizing

Communication Skills

- Use of modular and component units
- Study architectural achievements and major trends

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Floor Plans

SUB OBJECTIVE 34: The student will demonstrate ability to develop and draw a floor plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a working floor plan on a 1/4" = 1' scale.

A. Draw in outside wall lightly, then all partitions.
B. Draw in all doors and windows lightly.
C. Draw center line of all doors and windows from their width.
D. Draw in all plumbing fixtures lightly.
E. Draw in kitchen cabinets, vanity and linen closets.
F. Label all cabinets for special detail drawings.
G. Heavy up all wall lines.
H. Finish windows and doors.
I. Draw in all electrical symbols; including ceiling outlets, wall bracket outlets, base and wall plug outlets (convenience outlets), switch locations for lights and fixtures, 220 outlets for stove or water heater and vapor proof ceiling light for bathroom.
J. Draw in plumbing symbols; include gas connections, plumbing fixtures with dimensions and ductwork for heating and air conditioning.
K. Draw in special built-ins.
L. Add bath and kitchen details.
M. Prepare door and window schedule.
N. Letter room titles and titles of drawing.

II. Students develop and prepare a complete floor plan.

ENGINEERING, SUPPORT & MANAGEMENT SERVICE

CONTENT TITLE: Floor Plans

SUB OBJECTIVE 35: The student will demonstrate ability to dimension a working floor plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates dimensioning a floor plan.

A. Illustrate dimension lines (unbroken lines with dimensions placed above the lines).
B. Demonstrate using foot and/or inch marks.
C. Mention that dimensions of more or less than one foot are expressed in feet and inches or just inches.
D. Illustrate technique of reading dimensions from the right or bottom of the drawing.
E. Demonstrate placing overall building dimensions on the outside of other dimensions.
F. Demonstrate method of indicating room sizes.
G. Illustrate methods of indicating door and window sizes (may be shown on door and window schedule or dimensioned to their center line).
H. Mention that rooms are dimensioned from wall to wall exclusive of wall thickness.
I. Demonstrate indicating stair risers and over length, with arrow indicating up or down.

II. Students dimension their floor plans.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to arrange, lay out and design a no-scale plan for an approximately 1200 square foot structure for the requirements of a five member family.

SOURCES OF INFORMATION

Federal Housing Administration, Department of Housing and Urban Development, Minimum Property Standards for One and Two Living Units, (Order from GPO #HH2.17/4: 965).

Hepler, Donald E. and Paul I. Wallach, Architecture Drafting and Design, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Weidhaas, Ernest R., Architectural Drafting and Design, (Allyn Bacon, Inc.: Rockleigh, New Jersey 07647), 1968.

Wyatt, William E., General Architectural Drawing, (Chas. A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Post-secondary career planning
- Review of junior and senior college catalogs
- Group counseling
- Review employment prospects for those students not planning post-secondary education and training

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: No-Scale Plans

SUB OBJECTIVE 36: The student will demonstrate ability to draw a no-scale plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate the requirements for a no-scale sketch. Demonstration will include:

A. How to lay out and design a no-scale sketch.
B. Correct proportion of rooms.
C. Appropriate style, size and arrangement.
D. The arrangement of doors and windows.
E. Need for two or more different elevations.
F. Layout of a floor plan, limited to the following rooms:

1. Living room.
2. Dining room.
3. Kitchen.
4. Child's bedroom.
5. Guest bedroom or a room for two larger children.
6. Family room or master bedroom.
7. 3/4 bath for master bedroom.
8. Family bath.
9. Necessary porches, halls and entrance hall that is required for convenience.

G. The necessity to stay within approximately 1200 square feet.
H. The arrangement and placement of kitchen and bath.
I. The advantage of minimum hall space.
J. The requirements for correct entrance hallway and guest closet layout.
K. The placement of closets and storage space for maximum convenience.

II. Student makes a no-scale drawing of approximately 1200 square feet of house.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to plan, design, lay out and prepare all necessary plans, details, schedules, etc. for a two story house with a basement.

SOURCES OF INFORMATION

Federal Housing Administration, Department of Housing and Urban Development, Minimum Property Standards for One and Two Living Units, (Order from GPO #HH2.17/4: 965).

Hepler, Donald E. and Paul I. Wallach, Architecture Drafting and Design, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1965.

Muller, Edward J., Architectural Drawing and Light Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1967.

Weidhaas, Ernest R., Architectural Drafting and Design, (Allyn Bacon, Inc.: Rockleigh, New Jersey 07647), 1968.

Wyatt, William E., General Architectural Drawing, (Chas. A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Total review of math requirements for architectural students

Science

- Total review of science requirements for architectural students

Communication Skills

- Total review of occupational and career literature leading to employment and/or further education and training

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Large Single-Family Dwellings

SUB OBJECTIVE 37: The student will demonstrate ability to draw a stairway.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a stairway.

A. Rough stairwell opening, first floor; provide for double joist (2" x 8"), header (2" x 8" stairwell header), finished floor, first floor, sub-floor, finish stringer (carriage), headroom (minimum 6'8"), landing (top or bottom of stairs), platform and joist hangers.

B. Prepare rough and finish drawings for the staircase. Include bull nose, handrail, newel, nosing, riser (7-1/2" normal), run, tread (10" normal), unit rise, unit run, winder, baluster, total tun, finished floor, ground floor and sub-floor.

C. Discuss the different types of stairs or stairways used such as single flight (straight run), two flights with landing between flights, "L" shape or 90° turn with one or more intermediate landings between floors, "U" shape of 180° turn with full width landing at turn in "U", circular stairways and elliptical stairways.

D. Discuss dimensions of standard stairways.

1. Minimum width of stairs should be no less than 3' (4' is preferred).
2. 6'8" headroom height from stair tread to ceiling should be allowed.

E. Dimension stairwell opening.

F. Dimension total staircase run.

G. Construct distance from bottom of top tread (or first floor) to top of nosing (first, sub-floor and finished floor).

II. Students draw a stairway.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Large Single-Family Dwellings

SUB OBJECTIVE 38: The student will demonstrate ability to draw a fireplace detail.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a fireplace detail. Drawing will include:

A. Foundation; include basement floor, or ground floor with footing, ash pit, ash pit door (clean-out door), vent brick, ash dump, hearth and list, materials, reinforcing and construction.

B. Fireplace; include welded steel prefabricated fire box or fire brick lining (self made fire box), angle iron brace for lintel bar (usually 4"x 1/4"angle iron), damper, face (rock or brick), smoke shelf, air space around wood framing (usually 2") and mantel detail.

C. Chimney; include smoke chamber and throat, flue lining, flue support, steel anchor straps, chimney cap, (chimney should be at least 2' above ridge board) and flashing.

II. Student draws a fireplace detail.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Large Single-Family Dwellings

SUB OBJECTIVE 39: The student will demonstrate ability to draw a foundation and framing plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a foundation plan for a basement.

A. Select fill and indicate on drawing. Provide for vapor barrier.
B. Cover earth with polyethylene membrane.
C. Use 4" concrete floor with 6' x 6' - 10/10 wire mesh.
D. Basement floor to 2 x 10 floor joists (7'10" minimum).
E. Draw exterior walls (10" placed concrete foundation walls, T foundation with keyway).
F. Add 4" cap block.
G. Add termite shield.
H. Provide a 2 x 6 sill plate.
I. Use 2 x 10 joists (16" o.c., with insulation).
J. Use interior concrete beams for slab at least every 15' and always under bearing partitions.
K. Draw girders.
L. Provide for a floor drain or sump pump.
M. Indicate that outside of basement should be covered with 2 layers of 15 pound felt and hot mop.
N. Draw fireplace (foundation).
O. Draw staircase (foundation).

II. Students draw foundation plan for a basement.

III. Instructor demonstrates drawing a ground floor framing detail and plan.

A. Draw 2 x 10 floor joist @ 16" o.c. with insulation.
B. Draw 2 x 6 sill plate.
C. Use continuous x - Bridging.
D. Render fireplace opening (double joist).

Continued...

CONTENT TITLE: Large Single-Family Dwellings (Continued)

SUB OBJECTIVE 39: The student will demonstrate ability to draw a foundation and framing plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

E. Render stairway opening.
F. Use double joists under supporting partition studs.
G. Use a 4 x 10 supporting beam under joist girder and a ledger strip with concrete columns.
H. Indicate fire stop blocking.
I. Allow for sub-floor.
J. Draw finished floor.
K. Draw knee brace.
L. Draw first floor studs with sole plate.

IV. Students draw ground floor framing detail and plan.

V. Instructor demonstrates drawing second-floor framing detail and plan. Drawing will include:

A. 2" x 8" floor joists, 16" o.c. with insulation.
B. Firestop blocking.
C. 1" x 6" ribbon.
D. Header (2" x 8").
E. Fireplace opening (trimmers and two headers).
F. Staircase opening (trimmers and headers).
G. Sub-floor.
H. Flooring paper.
I. Finish floor.
J. Second floor studs and sole plates.

VI. Students draw a foundation and framing plan.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Large Single-Family Dwellings

SUB OBJECTIVE 40: The student will demonstrate ability to sketch a typical two story wall section.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate sketching a two story typical wall section. Drawing will include:

A. Foundation section. (Construction details may be the same as for basement foundation plan with the exception that all slab details are omitted.)

B. Ground level wall section. The following details are suggested: 2 x 4 plates, flashing, 1/2 x 8 anchor bolts 4' o.c., base and shoe, wall ties, every 4th course with corrugated galvanized wall ties, 2 x 4 studs 16" o.c. with insulation, 3/4 sheathing material or treated celotex sheets, 15 pound felt, 1 air space, brick or cut stone with soldier course at top, two 2 x 3 plates, 1/2 sheet rock (gypsum board) or wood paneling with ceiling tile, 2 x 8 joist @ 16" o.c., with insulation, with 2' x 8" cut-in, 3/8 soffit-w/molding, ship lap or 1/2 plywood sub-floor, oak finish floor, base and shoe, 2 x 4 plate, 2 x 4 studs 16" o.c. with insulation, 15 pound felt on studs, 105 siding or vertical or horizontal siding, two 2 x 4 double plates, 2 x 6 ceiling joists, 16" o.c. with insulation, 1 x 4 let in brace (corner brace).

C. Roof. The following details are suggested: 2 x 6 ceiling joists, 16" o.c. with insulation, 2 x 6 rafters 16" o.c., decking, ship lap or 1/2 plywood, 15 pound felt, metal gravel guard or flashing, built-up tar and gravel roof or asphalt shingles, fascia, soffit with 2" continuous air vent and screen, blocking, roof pitch, roof framing.

II. Students sketch a typical two story wall section.

ENGINEERING DRAFTING

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to draw and contour a topographic map.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, TM-233, (Order from GPO, Number D101.11: 5-233/2), 1964.

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Hoelscher, Springer and Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Grids and contours
- Degrees and angles
- Elevations

Science

- Physical geography

Communication Skills

- Technical literature
- Manufacturer's literature
- Student Resource Manual

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Topographic Maps

SUB OBJECTIVE 1: The student will demonstrate ability to draw a topographic map.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a topographic map. Drawing and demonstration will include:

A. Reducing field notes from surveyor's notes using surveying terms. Include indicators for azimuth, bearing and distance, deflection angle, magnetic north, true north, traverse, station, B.M. (Bench Mark), T.B.M., P.C., P.I., P.T., grids, closure, station point and numbers, time and temperature, elevations, cut and fill.

B. Indicating information for legal description. Include indicators for magnetic north, acreage, location of monuments, description of right of way or easements, name of property owner, title, scale and date, boundaries, fences and walls, buildings, highways and railroads.

C. Setup and parts of a surveying instrument. Include tripod legs, telescope, bubble tube, horizontal bar, tangent clamp screw, slow motion screw, leveling head, leveling screw, foot plate and instrument case.

D. Symbology used for highways, railroads, fences, rock walls or fences, buildings, lakes (dry or wet), ponds, rivers, creeks and streams, mines or quarrys, bridges, dams, telephones, cemeteries, churches, schools, fields (crops), trees (forests), cleared land, towns, utilities, valleys, hills, mountains, swamps and marshes.

E. Plotting contour lines and indicate scale used.

F. Contour maps; include demonstration of special drafting equipment such as contour pens, railroad pens, curves, proportional dividers, lettering devices, cross-section papers, aerial photographs, pantographs and planimeters.

II. Students draw a topographic map.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Topographic Maps

SUB OBJECTIVE 2: The student will demonstrate ability to contour a topographic plot.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates contour and drawing requirements for topography maps.

A. Construct a 50' grid system (smaller in critical areas), or a grid system not to exceed one hundred feet apart.
B. Plot an elevation (from data contained in field book) for each intersection of grid system.
C. Connect points of like elevation with contour lines. Do this on 5' intervals.
D. Indicate all existing elevations, field notes or United States Geodetic Survey data which may be helpful if specified on plot or contour map.
E. Utilize all existing aerial photographs and existing field notes to establish contour lines.
F. Construct elevations at all corners of subdivisions.
G. Within subdivision boundaries, draw 1' contour intervals for grades of 2% or less, 2' contour intervals for grades of 2% to 4%, 5' contour intervals for grades of more than 4% and 200' contours outside the boundary of the subdivision, if the topography is irregular.
H. Contour location of creeks, washes, gulleys or existing dams that might cause flooding or affect storm sewer or waste water systems.

II. Students draw topographic maps.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to compute, survey and close a city lot.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, TM5-233, (Order from GPO, Number D101.11: 5-233/2), 1964.

Brinker, Russell C., Elementary Surveying, (International Textbook Co., Division of Intext Educational Publishers: Scranton, Pennsylvania 18515), 1969.

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Hoelscher, Springer and Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Computing area formula
- Tangent angles and curves
- Converting old measurements to whole numbers and decimals

Communication Skills

- Metes and bounds description
- Legal descriptions
- City or county map

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: City Lots

SUB OBJECTIVE 3: The student will demonstrate ability to locate and survey a city lot.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates how to locate and survey a city lot.

   A. Obtain record from city clerk's (or county clerk's) office.
   B. Locate property on the ground.
   C. Run a closed traverse occupying all corners, if possible.
   D. Set a monument at each corner.

II. Student locates and surveys a city lot.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Rerunning Existing Surveys

SUB OBJECTIVE 4: The student will demonstrate ability to rerun existing survey and computing the area of enclosed property.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates re-running an existing survey and computing the area of enclosed property.

A. Secure description and map of area from county clerk's office.
B. Convert all old compass bearings to true bearings.
C. Convert any lengths given in rods, chains, poles, varas, etc., to feet and decimals of a foot.
D. Follow metes and bounds and old map in relocating existing monuments or replacing obliterated or lost corners.
E. Prepare map of area.
F. Divide area into triangles to compute area.
G. Compute area using formula: $A = \sqrt{s(s-a)(s-b)(s-c)}$

Where:
A = area
a = 1st side of triangle
b = 2nd side of triangle
c = 3rd side of triangle
$s = 1/2\ (a + b + c)$.

II. Student reruns an existing survey and computes the area of enclosed property.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Closures

SUB OBJECTIVE 5: The student will demonstrate ability to plot a lot closure from a field book survey.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing a lot closure.

A. Establish existing boundaries; plot boundaries by turning all angles with a protractor.
B. Construct tract(s) and label property owners.
C. Compute and indicate exact acreage for tract.
D. Establish and label adjacent property owners.
E. Compute distance between angles of boundary survey.
F. Compute exterior boundaries; make closure to within 5' of closing on drawing.
G. Compute layout and closure of streets in subdivisions and plot them on paper.
H. Compute street lengths with curve data; plot all angles with a protractor.
I. Compute all points of intersection (P.I.) for curve data and plot them on drawing.
J. Compute all points of curve (P.C.) for curve data and plot them on drawing.
K. Compute all lengths of cord (L.C.) for curve data and plot them on drawing.
L. Compute all points of tangent (P.T.) for curve data and plot them on drawing.
M. Compute all radii of curves for curve data and plot them on drawing.
N. Compute all central angles for curve data and plot them on drawing.
O. Compute all tangent angles for curve data and plot them on drawing.
P. Compute layout and closure of blocks and lots, using field book data, and plot them on paper.
Q. Compute layout and closure of alleys and easements from field book data and plot them on paper.

Continued...

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Closures (Continued)

SUB OBJECTIVE 5: The student will demonstrate ability to plot a lot closure from a field book survey.

SUGGESTED ACTIVITIES: (Students and Teachers)

R. Label blocks by number, lot number, bearings and distances of property lines for all lots where buildings are intended to be set back.

II. Students perform a lot closure

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to draw, label and verify a preliminary subdivision plot.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, TM-233, (Order from GPO, Number D101.11: 5-233/2), 1964.

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Hoelscher, Springer and Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Vocabulary development
- Student Resource Manual
- Working drawings and symbols

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Preliminary Subdivisions

SUB OBJECTIVE 6: The student will demonstrate ability to draw a preliminary subdivision plot.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates computing and drawing a preliminary subdivision.

A. Draw existing street and property lines in dashed lines. Record volume, page and street numbers.
B. Draw proposed street and property lines.
C. Draw exterior property boundary closures showing iron pins and concrete monuments.
D. Compute and construct boundaries of new easements; indicate size and location and show intended application (i.e., utility, drainage, etc.).
E. Compute and construct boundary ties; indicate bearings and distances.
F. Compute and construct all curve data with bearings and distances for I, R, T, A, L.C. and curve designation.
G. Compute and construct all arc segment data.
H. Compute and construct all sub-chord lengths and deflections.
I. Compute and construct all extensions of curves beyond the outboundaries of the plot of subdivision.
J. Compute and construct additions of straight-line distances.
K. Compute and construct building set-back lines.
L. Compute and construct closure sheets on each street and block with curve data sheets for each curve.
M. Compute and construct closure sheets on each lot using minimum proposed lot sizes of 50' interior lot widths and 60' corner lot widths.

II. Students draw a preliminary subdivision plot.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Preliminary Subdivisions

SUB OBJECTIVE 7: The student will demonstrate ability to label and verify requirements for a preliminary subdivision plot.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates labeling and verifying requirements for a preliminary subdivision plot. Labeling will include:

A. Date proposed subdivision was submitted.
B. Scale used (typically, 1" = 100').
C. North arrow.
D. Name of owner and engineer.
E. Name of proposed subdivision, proposed street, block number, lot number and lot dimensions.
F. Key location map of area, showing all major highways.
G. Existing buildings and man made topographic features.
H. Existing railroads, drainage and water courses by traverse.
I. Field book number and page and job number with proposed plat.
J. Exact acreage to be subdivided.
K. All special requirements; obtain engineer's signature and surveyor's seal.

II. Students draw a preliminary subdivision plot.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to design, draw, label and verify a final subdivision plot.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, TM-233, (Order from GPO, Number D101.11: 5-233/2), 1964.

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Hoelscher, Springer and Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Student Resource Manual
- Introduction to building codes and restrictions

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Final Subdivisions

SUB OBJECTIVE 8: The student will demonstrate ability to draw a final subdivision plot.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates computing and drawing a final subdivision plot.

A. Draw existing street and property lines in dashed lines, on linen, in ink, with existing volume and page numbers given.
B. Draw proposed street and property lines.
C. Construct plot closures, showing iron pins and concrete monuments.
D. Indicate new easements on plot with size and location; show if used for utility or drainage, etc. with minimum width of 10 feet (may be 5 feet on either side of the property line).
E. Indicate bearing ties and distances of existing easements and their use(s).
F. Indicate boundary ties (bearings and distances).
G. Compute all curve data (bearing and distances including I, R, T, A, L.C. and curve designations).
H. Compute all arc segment data.
I. Compute all sub-chord lengths and deflections.
J. Compute extensions of curves beyond outboundary of plot.
K. Compute additions of straight-line distances.
L. Draw building set-back lines.
M. Prepare closure sheets on each street and block with curve data sheets for each curve.
N. Indicate concrete monuments (to be placed at all corners or boundary lines, separation not to exceed 1800 feet).

II. Students draw a final subdivision plot.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Final Subdivisions

SUB OBJECTIVE 9: The student will demonstrate ability to design and draw a final subdivision plat.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates designing and drawing a final subdivision plat.

A. Draw adjacent subdivisions, all recorded subdivisions, and record all volume and page numbers, re-divided subdivisions ("resubs").

B. Indicate lot numbers and block numbers, with proposed street names.

C. Design lot sizes using minimum proposed lot sizes of 50' interior lot widths and 60' corner lot widths.

D. Design intersections using minimum property line radii of 15' for acute angles less than 80°.

E. Indicate county roads, existing streets and culverts.

F. Indicate placement of septic tanks and their sizes (if sewerage system is not available).

G. Indicate location of all permanent monuments and ties to subdivisions.

H. Include notarization paragraph, signature, date and seal.

I. Prepare city or county approval block; obtain signature of chairman, secretary, commissioner and director of planning, etc.

J. Indicate first check completed and date(s) corrections were checked.

II. Students draw final subdivision plat.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Final Subdivisions

SUB OBJECTIVE 10: The student will demonstrate ability to label and verify data for a final subdivision plat.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor outlines items requiring correct labeling and verification for a final subdivision plat.

   A. Indicate and verify adjacent owners of unplatted land (volume and page).
   B. Prepare legend.
   C. Indicate scale.
   D. Draw North arrow.
   E. For adjacent subdivision, indicate and verify records of "subs" and "resubs", with book and page, lots, blocks and streets; common boundaries (including bearing, distance, pins and monuments if found); locations(s) and name(s) of easements.
   F. Label name of subdivision with all street names and widths.
   G. Label all special requirements with engineer's signature and seal as a surveyor.
   H. Label field book number, page and job number on plat.
   I. Label all dimensions.
   J. Label sidewalk locations.
   K. Prepare a signed, acknowledged statement dedicating all streets, alleys, easements and parks to public use.

II. Students label and verify data on final subdivision plat.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to draw and/or design and label water distribution systems.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, TM-233, (Order from GPO, Number D101.11: 5-233/2), 1964.

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Hoelscher, Springer and Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Technical water system literature
- Sample drawings of systems
- Vocabulary development
- Student Resource Manual

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: City Water

SUB OBJECTIVE 11: The student will demonstrate ability to draw an old water distribution system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing an old water distribution system. Drawing will include:

   A. Streets and easement lines; designate names of right-of-ways, with widths.
   B. Property lines with lot and block numbers and owners if possible.
   C. Existing system at proposed tie-in points. (Indicate size, location, depth and type of pipe.)
   D. Existing mains; indicate size and location of valves, hydrants and major services.
   E. All items to be replaced or repaired during construction of mainline, walks, driveways, culverts, curbing, paving, utility lines, fences, signs, bridges, etc.
   F. Match lines and reference lines to join sheets or strips, when drawing must occupy more than one sheet.
   G. Detail sheet showing meter, valves, hydrant settings at typical locations, service and other taps, encasement and blocking, trenching, laying and backfill, paving replacement, hangers, piers and special valve boxes.

II. Students draw a water distribution system.

CONTENT TITLE: Water Distribution Systems

SUB OBJECTIVE 12: The student will demonstrate ability to draw a new water distribution system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a new water system.

A. Indicate water main size, location and class type.
B. Provide for a valve system for "shut outs," at most intersections. Indicate size, location and type.
C. Indicate and label pipe fittings required.
D. Indicate location of fire hydrants (maximum separation is usually 500 feet).
E. Draw and indicate location of new services which are not in driveways or sidewalks.
F. Indicate construction and relocation of existing services.
G. Indicate size and type of pipe and fittings used with services.
H. Draw and indicate location of service boxes.
I. Label preconstruction surface of streets or easements.
J. Plot a corner section profile of street or easement and show depth, location and size of proposed main with valves and existing and proposed piping elevations to meet area depth requirements.

II. Students draw a new water system.

CONTENT TITLE: Water Distribution Systems

SUB OBJECTIVE 13: The student will demonstrate ability to label a water distribution system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates labeling a water distribution system.

A. Label all street names in area, drawing key location map of area if necessary.
B. Label all main sizes and locations, valve sizes, fire hydrants and services in proposed area.
C. Construct an enlarged detail drawing of major connections or a detail service sheet.
D. Draw North arrow.
E. Indicate scale used.
F. Include legend.
G. Label all trees, walks, driveways, culverts, curbing and utility lines that will be crossed with proposed main and services.
H. Label all special requirements.
I. Label, on contour or elevation profile, all high points (air trapping) in main.
J. Label field book number, page and indicate job number on each sheet.
K. Draw title sheet or approval block(s).
L. Obtain engineer's signature and seal; obtain other signatures as required.

II. Students label a water system drawing.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to design, draw, and label a waste water collection system.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, TM5-233, (Order from GPO, Number D101.11: 5-233/2), 1964.

Brinker, Russell C., Elementary Surveying, (International Textbook Co., Division of Intext Educational Publishers: Scranton, Pennsylvania 18515), 1969.

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Hoelscher, Springer and Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Technical waste water systems literature
- Sample drawings of waste water systems
- Symbols

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: City Sewers

SUB OBJECTIVE 14: The student will demonstrate ability to design and draw a waste water collection system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates designing a waste water collection system.

A. Draw streets and easement lines; designate names of right-of-ways, with widths, using plat drawing.
B. Draw property lines with lot and block numbers and owner's name if possible.
C. Draw details of existing system at proposed tie-in points, with size, location, elevation, direction of flow and type of pipe.
D. Draw details of existing mains, sizes and locations, with existing manholes and determine flow requirements for size of mains proposed.
E. Indicate size, material and location of new mains, manholes, cleanouts, fittings and services.
F. From field survey, determine and label station numbers, increasing up stream, on both plan and profile for all M.H.'s, C.O.'s, P.C., P.T., P.C.C., P.R.C. and P.I.'s.
G. Apply match lines and reference lines where applicable.
H. From survey field notes, indicate all items to be replaced or repaired during construction of mains, such as trees, walks, driveways, culverts, curbing, paving, utility lines, fences, signs, bridges, etc.
I. Prepare a detail sheet showing ordinary manholes, manhole drop connections, cleanout stacks, service and other connections, encasement and blocking, trenching, laying and backfill, paving replacement, hangers, piers and special structures.

II. Students design and draw a waste water collection system.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: City Sewers

SUB OBJECTIVE 15: The student will demonstrate ability to draw the plan and profile drawings for a waste water collection system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing plan and profile for a waste water collection system.

   A. Draw plan on a large scale, with street or main in center of paper, showing all information from overall layout sheet of waste water system.
   B. Draw proposed main; indicate size and location from center-line or road line of street.
   C. Locate and draw new service; it should be separated from water, driveways and sidewalks.
   D. Indicate size and type of pipes and fittings used with service.
   E. Construct profile plot drawing. Indicate existing ground line, with proposed ground line and plot existing mains and manhole elevations. Compute flow for proposed main and necessary drop according to local codes.
   F. Provide for a manhole every five hundred feet or at each street intersection, main intersection, etc. Provide cleanouts at end of each main line.
   G. Plot all Y-branch connections.
   H. Using survey and main depth, figure cut sheets for proposed main.
   I. Plot all rock elevations on profile obtained from test holes drilled on job site.

II. Students draw plan and profile for a waste water collection system.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: City Sewers

SUB OBJECTIVE 16: The student will demonstrate ability to label a waste water collection system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates labeling a waste water collection system. Labeling will include:

A. All street names in area, drawing key location map if necessary.
B. Profile all main sizes, direction of flow, type of pipe and elevation in profile.
C. North arrow.
D. Scale used in both plan and profile.
E. Legend.
F. All trees, walks, driveways, culverts, curbing and utility lines in profile that will be crossed with proposed main and services.
G. Title sheet or approval block(s).
H. Contours or elevations of area necessary to show maximum serviceable area and direction of fall of waste water system served from this pipe, (overall map of collection system detail).
I. Field book number, page and job number on each sheet.
J. Utility lines on master plan to coincide with utility lines on profile.
K. All special requirements and obtain engineer's signature and seal.

II. Students label a waste water collection system.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: City Sewers

SUB OBJECTIVE 17: The student will demonstrate ability to compute and stake out a sewer line.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates computing and staking out a sewer line.

A. Run profile of ground where line is to be laid.
B. Establish gradient of slope (grade).
C. Set station stakes (50' intervals).
D. Set up instrument at convenient spot and obtain H.I. (height of instrument) by back-sighting to a point of known elevation.
E. Calculate grade rod for each station by subtracting grade elevation (obtained from profile) from H.I.
F. Take ground shots at each station to obtain ground rod.
G. Compute cut or fill at each station by subtracting ground rod from grade rod.
H. Mark station stakes with station number and amount of cut or fill.
I. Set target at proper reading on rod so that base of rod is at grade or at an even number of feet above or below grade.
J. Drive stakes to depth so that horizontal cross hair coincides with center line of target offsetting stakes from center of pipe line so they will not be disturbed during construction.

II. Students compute and stake out a sewer line.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will design, draw and label a city sewer system.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, TM-233, (Order from GPO, Number D101.11: 5-233/2), 1964.

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Hoelscher, Springer and Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- City, County, State and Federal requirements
- Student Resource Manual
- Representative samples of city sewer systems

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Storm Sewers

SUB OBJECTIVE 18: The student will demonstrate ability to design and draw a storm sewer drainage system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates designing and drawing a storm sewer drainage system.

A. Draw plan of area; include streets and easement lines, designation of names of right-of-ways and widths.
B. Draw plan of area showing property lines with lot and block numbers and owner's names if possible.
C. Draw topographic map of subdivision and area showing water drainage, runoff water for area and existing locations and design runoffs for inlets, lines and ditches.
D. Calculate and draw runoff water from all commercial areas; do this per block for residential areas and per street for all streets in the area.
E. Calculate and draw runoff water carried through area by drainage ditches or drainage from nearby subdivisions or areas.
F. Indicate by location existing inlets, lines and ditches.
G. Draw and indicate size and location of existing mains, ditches, inlets, manholes and major facilities near the proposed area which will carry water from the proposed area.
H. Calculate and draw proposed new mains; indicate their size, material of construction and location. Also indicate ditches, manholes, fittings, inlets and special drain constructions.
I. Draw all items to be replaced or repaired during construction of storm sewer mains such as trees, walks, driveways, culverts, curbing, paving, utility lines, fences, signs, bridges, drainage ditches, etc.
J. Draw a detail sheet, showing ordinary manholes, junction boxes, culverts, headwalls, inlets, encasements and blocking, trenching, laying and backfill, paving replacement, ditch sections and special structures.

II. Students draw a storm sewer drainage system.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Storm Sewers

SUB OBJECTIVE 19: The student will demonstrate ability to draw the profile drawings for a storm sewer drainage system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing the profile for a storm sewer drainage system.

A. Construct (from field survey notes) ground line staking for storm sewer.

B. Indicate, on plan and profile drawings, station numbers. Numbers should increase upstream and be applied to all manholes, inlets, headwalls, P.C., P.T., P.C.C., P.R.C. and P.I.'s.

C. Draw (on profiles) all mains, ditches and long inlet leads. Show elevation gradients of ground main elevations and flow lines.

D. Plot all rock elevations obtained from test holes drilled on job site.

E. Construct, using the survey and main depth charts, the figure cut sheets for proposed main.

F. Plot (on profile) all manholes and all input-output elevations with percent flow throughput.

G. Label all new materials, sizes, dimensions and special construction areas.

H. Employ match lines where necessary.

I. Construct contours or elevations, where necessary to show drainage area, drainage pattern and flooding area of ditches or streams.

II. Students draw the profile for a storm sewer drainage system.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Storm Sewers

SUB OBJECTIVE 20: The student will demonstrate ability to label a storm sewer drainage system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates labeling a storm sewer drainage system. Labeling will include:

   A. All street names in area, drawing key location map of area if necessary.
   B. Main size, location, depth and type, plan and profile, if needed.
   C. North arrow.
   D. Scale.
   E. Legend.
   F. All trees, walks, driveways, culverts, curbing and utility lines in plan and profile that will be crossed with proposed main and inlet leads.
   G. A title sheet or approval block.
   H. Profile of all high and low points in main (on contour or elevation).
   I. Field book number and page, place job number on each sheet.
   J. All special requirements; obtain engineer's signature and seal.

II. Students label a storm sewer drainage system.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to design, draw and label a gas distribution system.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, TM-233, (Order from GPO, Number D101.11: 5-233/2), 1964.

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Hoelscher, Springer and Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Codes and regulations
- System terminology

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Gas Lines

SUB OBJECTIVE 21: The student will demonstrate ability to design and draw a gas distribution system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a gas system.

A. Construct and draw plan of area. Include streets and easement lines; designate names of right-of-ways and their widths.

B. Construct plan of area showing property lines with lot and block numbers and owner's names if possible.

C. Construct details of existing mains in area of proposed tie-in points, with size, location, depth and type of pipe indicated.

D. Locate and indicate size, depth and type of pipe for proposed gas main.

E. Plot all pipes crossing gas main for depth, type, size and location.

F. Plan valving system to allow for small area shut-outs for repair of main (valving typically located at each street intersection).

G. Indicate all items to be replaced or repaired during construction of gas main, such as trees, walks, driveways, culverts, curbing, paving, utility lines, fences, signs, bridges, etc.

H. Locate new services, indicating size and type of pipe and fittings used in location of service (meter) box.

I. Apply match lines where necessary.

J. Develop detail sheet showing meter, valve, service and other taps, encasement and blocking, trenching, laying and backfill, paving replacement, hangers, piers and special valve boxes.

II. Students draw a gas system.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Gas Lines

SUB OBJECTIVE 22: The student will demonstrate ability to label drawings for a gas distribution system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates labeling a gas system. Labeling will include:

   A. All street names in area; draw key location map of area if necessary.
   B. Main size, location, depth and type of pipe in plan and profile if needed.
   C. North arrow.
   D. Scale.
   E. Legend.
   F. All trees, walks, driveways, culverts, curbing and utility lines that will be crossed with proposed main and services.
   G. Title sheet and approval block(s).
   H. Field book number and page; place job number on each sheet.
   I. All special requirements; obtain engineer's signature and seal.

II. Students label a gas system.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to design, draw and label underground telephone and electrical systems.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, TM-233, (Order from GPO, Number D101.11:5-233/2), 1964.

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Hoelscher, Springer and Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Technical readings on underground utility systems
- Student Resource Manual
- Vocabulary development

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Underground Telephone and Electrical Service

SUB OBJECTIVE 23: The student will demonstrate ability to design and draw an underground telephone and electrical system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates designing and drawing an underground telephone and electrical system.

A. Construct and draw plan of area using streets and easement lines. Designate names of right-of-ways and indicate widths.
B. Construct and draw plan of area showing property lines with lot and block numbers and owner's names if possible.
C. Locate and indicate size, depth and type of cable for proposed telephone and electrical cable.
D. Prepare detail drawings of proposed tie-in points, with existing cables. Indicate size, location, depth and types of cable.
E. Plot all pipe crossing telephone and electrical cable for depth, type, size and location.
F. Indicate items to be replaced or repaired during construction of cables such as trees, walks, driveways, culverts, curbing, paving, utility lines, fences, signs, bridges, etc.
G. Locate new services indicating size and type of cable and fittings used in locating services.
H. Apply match lines where required.
I. Construct a detail sheet showing manholes, service and other tie-ins, encasement, trenching, laying and backfill, paving replacement, hangers and piers.
J. Draw profile (using staking survey for cable). Plot existing ground line with proposed finished grade and plot existing and proposed cable (with manholes) to grade.
K. Plot on profile (from C & E) all pipe crossings for depth, type, size and location.

II. Students design and draw underground telephone and electrical systems.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Underground Telephone and Electrical Service

SUB OBJECTIVE 24: The student will demonstrate ability to label an underground telephone and electrical system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates labeling an underground telephone and electrical cable system. Labeling will include:

A. All street names in area, drawing key location map of area if necessary.
B. Cable size, locations, depths and types in plan and profile if needed.
C. North arrow.
D. Scale used for plan and profile.
E. A legend showing all repeated symbols and meanings.
F. All trees, walks, driveways, culverts, curbing and utility lines in plan and profile that will be crossed with proposed cable and services.
G. Title sheet or approval block(s).
H. On contour or elevation profile drawings all high and low points in cable casement.
I. Field book number and page; include job number on each sheet.
J. All special requirements and obtain engineer's signature and seal.

II. Students label drawings for underground cable systems.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to design, draw and label a set of city street plans.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, TM-233, (Order from GPO, Number D101.11:5-233/2), 1964.

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Hoelscher, Springer and Dobrovolny, Graphics for Engineers, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review of math requirements for job entry and/or higher education

Science

- Review of science requirements for job entry and/or higher education

Communication Skills

- Review of communication skills requirements for job entry and/or higher education
- Review of job and career opportunities
  - Job
  - Junior college or technical college
  - Four year college

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Street Plans

SUB OBJECTIVE 25: The student will demonstrate ability to design and draw a set of street plans with curbs and gutters.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates designing and drawing a set of street plans.

A. Draw plan of area showing streets and property lines with lot and block numbers and owner's names if possible. Designate names of right-of-ways and indicate widths.

B. Draw topographic map of subdivision and area, indicating and distinguishing between new and existing pavement, curbs, culverts and inlets. Show finished grade for unusual or difficult intersections.

C. Draw, on both plan and profile, indication of centerline of street, curb or paving line (both right and left), base limits and borrow ditch limits.

D. Place (from field notes) station numbers on centerline, intersections, property lines, curbs, centerline P.C., P.C.C., P.R.C., P.T. and P.I.'s, inlets and curb ends.

E. Draw centerline bearings or intersection angles; compute curve data on all curves on centerline, curb lines, curb returns and cul-de-sac property lines. Give I, R, T, A and deflection/ft. angles.

F. Determine minimum curb return radii; (for acute angles 80° or less, radii should be 25.00').

G. Indicate direction of curb drainage, inlets, high points and valley gutters; give inlet data, centerline stations and opening widths.

H. Provide station numbers increasing from left to right (West to East) and (South to North).

II. Students design and draw a set of street plans.

CONTENT TITLE: Street Plans

SUB OBJECTIVE 26: The student will demonstrate ability to design and draw the profile sections of a street plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates designing and drawing the profile section.

A. Prepare a drawing (from field survey notes) showing existing ground at centerlines and property lines (light, coded lines, proposed grade lines, centerlines and right and left curb tops, critical buried utilities and drainage, existing paving, curbs and critical surface drainage.

B. Provide maximum paving and curb grade breaks of 0.8 percent in 10' for a smooth contour.

C. Determine and indicate grade elevations and station numbers at even stations and 1/2 station points; likewise at P.C., P.C.C., P.R.C., P.T. and P.I.'s, curb and paving ends, vertical P.I., P.C. and P.T.'s and high and low points.

D. Calculate data for all vertical curves, giving right and left, also (where not obvious) vertical P.I.'s and elevations. Show V.P.C. and V.P.T., etc., by dimension.

E. Plot gradient and show slope of adjoining curbs or streets to fit grade breaks at junctions with other profiles.

F. Construct and show profiles and alignments of existing adjoining streets and future extensions for a sufficient distance to indicate a good fit to the ground and any difficulties that may be encountered at extension junctions.

G. Indicate gradients on profiles for all curbs. Indicate which curb is meant (right or left), or where not curbed, indicate centerline gradients and edge surface elevations, if any. Indicate ascending grade as (+), descending grade as (-).

Continued...

CONTENT TITLE: Street Plans (Continued)

SUB OBJECTIVE 26: The student will demonstrate ability to design and draw the profile sections of a street plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

H. Note locations and lengths of gutters to be depressed for valley gutters and give valley gutter flow line elevations at station centerlines.

I. Determine cut and fill data and prepare a profile of the roadbed. From this drawing, make cut and fill sheets for construction crew.

II. Students draw profile sections for a set of street plans.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Street Plans

SUB OBJECTIVE 27: The student will demonstrate ability to label a set of street plans.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates labeling a set of street plans. Labeling will include:

A. All street names in area, drawing key location map of area if necessary.
B. North arrow.
C. Scale.
D. Legend.
E. All trees, walks, driveways, culverts and utility lines that will be crossed or tied in proposed curbing or paving (in profile drawings).
F. All special requirements and obtain engineer's signature and seal.
G. Title sheet(s) or approval block(s).
H. Field book, number and page; put number on each sheet.
I. Match lines where necessary.
J. Sheet title, number and total number.
K. Overall sheet showing area covered by each sheet; indicate water flow on street, valley gutters, inlets and drain ditches.

II. Students label a set of street plans.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Street Plans

SUB OBJECTIVE 28: The student will demonstrate ability to draw curbs and gutters.

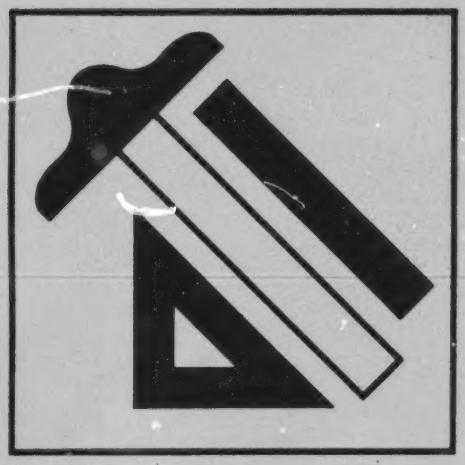
SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing curbs and gutters.

A. Construct or draw curb and gutter on plan and profile sheets.
B. Construct right and left curbs to comply with elevation of paving.
C. Draw plan and profile sheets.
D. Draw curbing on a smooth contour--no sharp breaks.
E. Plot right and left street elevation.
F. Plot elevation of right and left curb profile.
G. Demonstrate staking curbs.
H. Demonstrate reducing field notes.
I. Demonstrate figuring cut sheets.
J. Demonstrate plotting cut sheet profile.
K. Demonstrate use of cut sheets.

II. Students draw curbs and gutters.

ESTIMATING



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ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to estimate the cost of labor and materials for a concrete sidewalk.

SOURCES OF INFORMATION

Building Construction Estimating, (Frank R. Walker Co., McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020), 1971.

Cooper and Badzinski, Carpentry in Residential Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measurement
  - Whole numbers
  - Decimals
  - Fractions
- Square and cubic computations
- Tables, charts and graphs
- Formulas
- Percentages

Communication Skills

- Using tabulation sheets
- Blueprint reading
- Symbols
- Working Drawings
- Vocabulary development
- Student Resource Manual

CONTENT TITLE: Concrete Slabs

SUB OBJECTIVE 1: The student will demonstrate ability to estimate the cost of grading and excavating for a concrete walk.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of grading and excavation for a concrete sidewalk.

   A. Determine size of the excavation.
   B. Determine volume of the excavation.
   C. Determine labor requirement to loosen, shovel and load earth into wheelbarrows.
   D. Estimate cost to remove excess earth from job site.
   E. Tabulate results.

II. Student estimates cost of grading and excavating for a concrete walk.

CONTENT TITLE: Concrete Slabs

SUB OBJECTIVE 2: The student will demonstrate ability to estimate the cost of a sandbed under a concrete walk.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of a sandbed under a concrete sidewalk.

   A. Determine volume of sand fill needed.
   B. Calculate cost of sand. (Volume x unit price.)
   C. Estimate labor to spread and tamp sand.
   D. Calculate labor cost to spread and tamp sand (hours x rate).
   E. Tabulate the results.

II. Students estimate the cost of a sandbed under a concrete walk.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Concrete Slabs

SUB OBJECTIVE 3: The student will demonstrate ability to estimate the cost of forms for a concrete walk.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of forms for a concrete sidewalk.

   A. Determine total area of sidewalk
   B. Estimate lumber requirement for form work.
   C. Estimate labor to place forms and screeds.
   D. Tabulate results.

II. Students estimate the cost of forms for a concrete walk.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Concrete Slabs

SUB OBJECTIVE 4: The student will demonstrate ability to estimate the cost of steel reinforcing material for a concrete walk.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the steel reinforcing for a concrete walk.

A. List number of bars of each size and length.
B. Compute total linear feet of each size of bar.
C. Multiply linear feet by unit weight of bar size to find weight.
D. Add 10% for lapping bars (if applicable).
E. Multiply weight by unit cost of reinforcing bars.
F. Estimate labor to unload, stockpile and sort reinforcing steel.
G. Estimate labor to place and tie bars.
H. Tabulate results.

II. Students estimate the cost of steel reinforcing for a concrete walk.

CONTENT TITLE: Concrete Slabs

SUB OBJECTIVE 5: The student will demonstrate ability to estimate the cost of finishing a concrete walk.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of finishing a concrete walk.

   A. Compute area of walk.
   B. Determine amount of cement color, if required.
   C. Estimate labor to block walk into squares, if required.
   D. Estimate labor to flat and trowel the rough concrete.
   E. Tabulate results.

II. Students estimate the cost of finishing a concrete walk.

CONTENT TITLE: Concrete Slabs

SUB OBJECTIVE 6: The student will demonstrate ability to estimate the profit and overhead on a concrete walk installation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating profit and overhead for a concrete sidewalk.

   A. Determine annual business.
   B. Determine amount of annual fixed overhead expense.
   C. Calculate percentage of fixed expenses.
   D. Multiply job cost by this percentage factor and add this amount to cost for total job costs.
   E. Determine percentage of profit which may be added to job.
   F. Tabulate results.

II. Students estimate profit and overhead for a concrete walk.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Concrete Slabs

SUB OBJECTIVE 7: The student will demonstrate ability to prepare an estimate recapitulation and Summary Sheet.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing an estimate recapitulation (Recap) and Summary Sheet.

   A. Copy total quantities from quantity takeoff.
   B. List unit price and total price for material and labor for each item of construction.
   C. Add up totals for the complete estimate (Recap).
   D. Copy totals from the Recap for each item of construction.
   E. Add the sum of all items for total estimate (Summary Sheet).

II. Students prepare Recap and Summary Sheets.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to estimate the cost of labor and material to erect a frame garage over a concrete floor.

SOURCES OF INFORMATION

Building Construction Estimating, (Frank R. Walker Co., McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020), 1971.

Cooper and Badzinski, Carpentry in Residential Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Unit costs
  - Materials
  - Time
  - Labor
- Use of calculating equipment

Communication Skills

- Manufacturer's literature
- Catalogs
- Technical reading - tables, charts and graphs

CONTENT TITLE: Earthwork

SUB OBJECTIVE 8: The student will demonstrate ability to estimate the cost of grading, excavating and placing a sandbed under a concrete slab floor.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of grading, excavating and placing a sandbed under a concrete slab.

   A. Determine volume of excavation.
   B. Estimate labor cost to loosen, shovel and load excess earth.
   C. Estimate the cost to remove excess earth from job site.
   D. Determine cost of a sandbed.
   E. Tabulate results.

II. Students estimate the cost of grading, excavating and placing a sandbed under a concrete slab.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Concrete Slabs

SUB OBJECTIVE 9: The student will demonstrate ability to estimate the cost of a concrete slab.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of labor and materials for a concrete slab.

   A. Estimate material cost of screeds and forms.
   B. Estimate labor cost to set screeds and forms.
   C. Estimate cost of reinforcing steel.
   D. Estimate cost of sandbed.
   E. List size of slab by length, width and thickness.
   F. Calculate cost of slab.
   G. Calculate cost of finish work.
   H. Tabulate results.

II. Students estimate the cost of a concrete slab.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Frame Partitions

SUB OBJECTIVE 10: The student will demonstrate ability to estimate the cost of wood frame partitions for a frame garage.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating cost of labor and materials for a wood frame partition.

   A. List total linear feet of each partition by height.
   B. Determine lumber needed for each type of partition from chart.
   C. Determine nail requirements from chart.
   D. Calculate cost of material for partitions.
   E. Estimate labor to frame wall plates.
   F. Estimate labor to frame the partitions.
   G. Calculate total labor cost to frame plates and partitions.
   H. Tabulate results.

II. Students estimate the cost of labor and materials for a wood frame partition.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Sheathing

SUB OBJECTIVE 11: The student will demonstrate ability to estimate the cost of labor and materials required to place wood sheathing on a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of labor and materials to place wood sheathing on a frame building.

   A. Determine wall area to be sheathed.
   B. Determine roof area to be sheathed.
   C. Calculate amount of sheathing material required.
   D. Determine amount of sheathing paper required.
   E. Determine quantity of nails needed to apply sheathing and underlayment.
   F. Estimate cost of the labor to apply sheathing.
   G. Tabulate results.

II. Students estimate the cost of labor and material to place wood sheathing on a frame building.

CONTENT TITLE: Siding

SUB OBJECTIVE 12: The student will demonstrate ability to estimate the cost of labor and material required to erect exterior siding for a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of exterior siding for a frame building.

   A. Determine area to be covered.
   B. Determine quantity of siding required.
   C. Determine cost of nails.
   D. Calculate material cost of siding.
   E. Determine cost of labor required to erect siding.
   F. Tabulate results.

II. Students estimate the cost of exterior siding for a frame building.

CONTENT TITLE: Trim

SUB OBJECTIVE 13: The student will demonstrate ability to estimate the cost of labor and material required to place exterior trim on a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of labor and material to place exterior trim on a frame building.

A. Calculate number of lookouts needed for cornice.
B. Determine size and length of frieze board.
C. Determine size and length of soffit.
D. Determine size and length of fascia, boards and moldings.
E. Determine size and length of barge board and shingle strip.
F. Estimate cost of labor to place exterior trim.
G. Tabulate results.

II. Students estimate the cost of labor and materials to place exterior trim on a frame building.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Doors and Windows

SUB OBJECTIVE 14: The student will demonstrate ability to estimate the cost of materials and labor required to furnish and install doors and windows in a two car garage.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of furnishing and installing doors and windows in a two car garage.

   A. Determine cost of garage door and hardware, complete.
   B. Estimate labor to install door.
   C. Determine cost of windows, glazed.
   D. Estimate labor to install and trim windows.
   E. Determine cost of wood door with hardware, complete.
   F. Estimate labor to install and trim door.
   G. Tabulate costs of material and labor.

II. Students estimate the cost of furnishing and installing doors and windows in a two car garage.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Roof Structures

SUB OBJECTIVE 15: The student will demonstrate ability to estimate the cost of the roof structure for a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the roof structure for a frame building.

A. Determine the number of rafters required.
B. Calculate length of rafters.
C. Determine length of ridge board.
D. Estimate nails required.
E. Determine cost of material.
F. Determine labor cost of framing and erecting roof structure.
G. Tabulate all costs.

II. Students estimate the cost of the roof structure for a frame building.

CONTENT TITLE: Roofing

SUB OBJECTIVE 16: The student will demonstrate ability to estimate the cost of labor and material to roof a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of labor and material to roof a frame building.

   A. Determine area to be covered.
   B. Determine required quantity of asphalt shingles.
   C. Estimate nails required to lay roofing.
   D. Estimate cost of materials to apply roofing (nails and shingles).
   E. Estimate labor required to apply roof.
   F. Tabulate results.

II. Students estimate cost of labor and material to roof a frame building.

CONTENT TITLE: Paint

SUB OBJECTIVE 17: The student will demonstrate ability to estimate labor and material required to paint a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of labor and material required to paint a frame building.

   A. Compute area to be painted, including doors and windows.
   B. Determine amount of paint and painter hours required from the tables.
   C. Calculate cost of paint.
   D. Calculate cost of labor to apply paint (hours x rate).
   E. Add total costs of material and labor.

II. Students estimate labor and material required to paint a two car garage.

CONTENT TITLE: Wiring

SUB OBJECTIVE 18: The student will demonstrate ability to estimate the cost of electrical wiring for a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the electrical wiring for a frame building.

A. Obtain cost of lighting outlet and switch.
B. Obtain cost of circuit box, if required.
C. Compute length of wire and conduit (with fittings) needed.
D. Calculate price of wire and conduit (with fittings).
E. Estimate labor to set conduit.
F. Calculate cost of setting conduit.
G. Estimate labor to set boxes (if required).
H. Calculate cost of setting boxes.
I. Estimate labor to pull wire.
J. Calculate cost of pulling wire.
K. Estimate labor to install switch (and receptacle if required).
L. Calculate cost to install switch (and receptacle if required).
M. Add total costs of materials and labor.

II. Students estimate the electrical wiring for a frame building.

CONTENT TITLE: Overhead and Profit

SUB OBJECTIVE 19: The student will demonstrate ability to make provision for overhead costs and profit in an estimate.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates providing for overhead and profit in an estimate.

A. Determine annual business.
B. Determine annual fixed overhead expense.
C. Calculate ratio (percent) of overhead-to-business.
D. Multiply job cost by this percentage factor and add the result to total job costs.
E. Determine profit which may be added to job.
F. Tabulate results.

II. Students provide for profit and overhead in an estimate.

CONTENT TITLE: Recaps and Summaries

SUB OBJECTIVE 20: The student will demonstrate ability to prepare a Recap and Summary Sheet.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing an estimate recapitulation (Recap) and Summary Sheet.

A. Copy total quantities from quantity takeoff.
B. List unit price and total price of labor and material for each item of construction.
C. Add totals for complete estimate, (Recap).
D. Copy totals from Recap for each item of construction.
E. Add sum of all items for total estimate, (Summary Sheet).

II. Students prepare Recap and Summary Sheet.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to estimate the cost of labor and materials to build a residence consisting of a concrete slab with brick veneer and siding-frame construction.

SOURCES OF INFORMATION

Building Construction Estimating, (Frank R. Walker Co., McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020), 1971.

Cooper and Badzinski, Carpentry in Residential Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Volume discounts
- Overhead and profit figures

Communication Skills

- Vocabulary development
- Manufacturer's literature
- Catalog use
- Blueprint and spec usage

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Brick Veneer Walls

SUB OBJECTIVE 21: The student will demonstrate ability to estimate the cost of a brick veneer wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating brick veneer for frame walls.

A. Determine area of brick veneer.
B. Compute number of bricks required for job, (plus allowance for waste and breakage).
C. Compute mortar requirements (from the tables).
D. Calculate cost of brick (number of bricks x unit cost).
E. Calculate cost of mortar (cubic feet x unit price).
F. Estimate labor required to lay brick (from the tables).
G. Calculate cost of laying bricks (hours x rate).
H. Tabulate the costs (labor and materials).

II. Students estimate cost of a brick veneer for frame walls.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Roofs

SUB OBJECTIVE 22: The student will demonstrate ability to estimate the cost of labor and material required to roof a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of labor and material to roof a frame building.

A. Determine area to be covered.
B. Determine quantity of shingles required.
C. Estimate nails required to lay roofing.
D. Estimate cost of materials to apply roofing (nails and shingles).
E. Estimate labor required to apply roof.
F. Determine linear feet of gutters required.
G. Calculate materials cost of the gutters.
H. Estimate labor cost to hang gutters.
I. Determine number of downspouts required.
J. Calculate material cost of downspouts.
K. Estimate labor to hang downspouts.
L. Determine linear feet of ridge roll required.
M. Determine material cost of ridge roll.
N. Determine labor cost of setting ridge roll.

II. The student estimates the cost of labor and material to roof a frame building.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Insulation and Interior Finish

SUB OBJECTIVE 23: The student will demonstrate ability to estimate the cost of applying insulation and interior finish material in a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating costs of applying insulation and interior finish to a frame building.

   A. Determine quantity of various types of wool batts needed to insulate exterior walls and ceilings.
   B. Calculate material cost of insulation.
   C. Estimate labor cost to place insulating wool batts.
   D. Determine quantity of gypsum board needed for ceilings and walls (less openings).
   E. Determine amount of accessories required to install the gypsum board (see tables).
   F. Calculate price of gypsum board and accessories.
   G. Estimate labor needed to apply and finish gypsum board (see tables).
   H. Tabulate costs.

II. Students estimate the cost of labor and materials to apply insulation and interior finish in a frame building.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Millwork

SUB OBJECTIVE 24: The student will demonstrate ability to estimate the cost of labor and materials required to install cabinets, paneling, moldings, wood-base, stairs and other millwork incidental to the construction of a frame residence.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the millwork incidental to the construction of a frame residence.

A. Determine amount of wood-base needed for the job (linear feet).
B. Determine amount of picture molding needed for the job (linear feet).
C. Determine amount of wood wainscot or paneling needed for job (square feet).
D. Calculate cost of wood-base (feet x unit price).
E. Calculate cost of picture molding (feet x unit price).
F. Calculate cost of wainscot or paneling (square feet x unit price).
G. Estimate labor to place wood-base.
H. Estimate labor to place picture molding.
I. Estimate labor to place wainscot or paneling (hours).
J. Determine amount of shelving and rods needed in the closets.
K. Determine cabinet and case requirements.
L. Determine bathroom medicine cabinets and accessories needed.
M. Determine kitchen cabinet requirements.
N. Calculate cost of materials needed for cabinets, cases, closet shelving and rods.
O. Determine cost of medicine cabinet, bathroom accessories, kitchen cabinets and kitchen accessories.
P. Estimate labor to place closet shelving.
Q. Estimate labor to install hanging rods in the closets.
R. Estimate labor to set cabinets and cases.

Continued...

CONTENT TITLE: Millwork (Continued)

SUB OBJECTIVE 24: The student will demonstrate ability to estimate the cost of labor and materials required to install cabinets, paneling, moldings, wood-base, stairs and other millwork incidental to the construction of a frame residence.

SUGGESTED ACTIVITIES: (Students and Teachers)

S. Estimate labor to set medicine cabinets and other bathroom accessories.
T. Estimate labor to set kitchen cabinets and built-ins.
U. Estimate the material and labor for a fireplace mantel, if required.
V. Estimate the material and labor for a wood stair if required.
W. Tabulate costs of material and labor.

II. Students estimate millwork incidental to the construction of a frame residence.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Windows

SUB OBJECTIVE 25: The student will demonstrate ability to estimate the cost of material and labor to furnish, install and trim windows for a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating residential window cost.

A. Determine quantity and types of windows required.
B. Determine price (glazed) of windows.
C. Estimate labor (man-hours) required to set windows and erect trim, (see tables).
D. Determine quantity of material needed to trim windows.
E. Calculate cost of materials needed for window trim, (quantity x unit price).
F. Calculate labor cost of setting and trimming windows, (hours x rate).
G. Tabulate results.

II. Students estimate the cost of material and labor to furnish, install and trim windows for a frame building.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Doors

SUB OBJECTIVE 26: The student will demonstrate ability to estimate the cost of furnishing, installing and trimming doors for a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost to furnish, install and trim doors for a frame building.

   A. Determine quantity and type of doors needed.
   B. Determine interior and exterior hardware requirements of doors.
   C. Calculate cost of doors and hardware.
   D. Determine quantity of material needed for jambs, casings and trim, (linear feet).
   E. Calculate cost of jamb, casing and trim material.
   F. Estimate labor required to set jambs, fit and hang door, place stops and hardware, trim and case openings, (see tables).
   G. Tabulate the costs.

II. Students estimate the cost to furnish, install and trim doors for a frame building.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Floor Tiles

SUB OBJECTIVE 27: The student will demonstrate ability to estimate the cost of materials and labor to install resilient floor tiles on a concrete floor slab.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of labor and materials to install resilient floor tiles on a concrete slab floor.

   A. Determine area to be tiled.
   B. Determine type of tiles to be used (asphalt, cork, vinyl, asbestos, etc.) and thickness.
   C. Compute amount of tile needed, adding for waste.
   D. Estimate quantity of primer and asphalt cement needed to install tile.
   E. Calculate cost of tile, primer and cement.
   F. Estimate labor to lay and finish tile, (see table).
   G. Calculate labor cost, (rate x labor).
   H. Tabulate results.

II. Students estimate the cost of labor and materials to install resilient floor tiles on a concrete floor slab.

CONTENT TITLE: Paint

SUB OBJECTIVE 28: The student will demonstrate ability to estimate the cost of labor and materials required to paint the interior and exterior of a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the labor and materials to paint the inside and outside of a frame building.

   A. Determine area of work to be painted. Use plus factors for cornices, eaves, moldings, cupboards, etc. as specified in painting schedules.
   B. Determine type of paint and number of coats required.
   C. Read tables to determine labor and material requirements.
   D. Read charts to determine labor and material needed for special painting.
   E. Calculate cost of materials (gallons x price) and labor (hours x rate) for the work.
   F. Tabulate results.

II. Students estimate the cost of labor and materials to paint the interior and exterior of a frame building.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Wiring

SUB OBJECTIVE 29: The student will demonstrate ability to estimate the cost of residential electrical wiring for a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates an electrical wiring estimation for a frame building.

   A. Make a detailed takeoff of outlets, switches, length of wiring, fixtures and service entrance equipment.
   B. Calculate cost of the materials needed.
   C. Estimate labor to set service entrance equipment, (see table).
   D. Estimate labor to install wiring, (see table).
   E. Estimate labor to install switches and receptacles, (see tables).
   F. Estimate labor to install fixtures.
   G. Calculate cost of labor (hours x rate).
   H. Tabulate results.

II. Student estimates the cost of electrical wiring for a frame building.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Air Conditioning and Heating

SUB OBJECTIVE 30: The student will demonstrate ability to estimate the cost of heating and air conditioning a residence.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of heating and air conditioning a residence.

   A. Determine volume of space to be heated and air conditioned (cubic feet).
   B. Determine size of unit needed from tables.
   C. Determine cost of material and equipment delivered.
   D. Estimate labor to assemble and set up unit.
   E. Calculate cost to assemble and set up unit, (hours x rate).
   F. Determine cost of air and return air duct systems, (labor and materials).
   G. Determine cost of diffusers, registers, intakes, grills, etc.
   H. Determine cost of insulating ducts.
   I. Determine cost of electrical work, if any.
   J. Determine labor cost to balance system.
   K. Tabulate all costs.

II. Students estimate the cost of heating and air conditioning a residence.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Plumbing and Sewers

SUB OBJECTIVE 31: The student will demonstrate ability to estimate the cost of materials and labor for a residential plumbing and sewerage system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of materials and labor to install a residential plumbing and sewerage system.

A. Count number of fixtures to be used in house.
B. Use tables to estimate labor required to install each fixture.
C. Estimate material cost of fixtures, (from tables or supplier).
D. List linear feet of pipe required, by size.
E. Determine price of pipe.
F. Take 65% of pipe cost for fittings cost.
G. Take 80% of cost of pipe and fittings for cost of rough-in labor.
H. Take 25% of cost of fixtures for the cost of placing fixtures.
I. List linear feet of sewer pipe required, by size.
J. Determine cost of sewer pipe.
K. Estimate labor to lay sewer pipe, (from tables).
L. Tabulate results.

II. Students estimate the cost of labor and material for a residential plumbing and sewerage system.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Hardware and Accessories

SUB OBJECTIVE 32: The student will demonstrate ability to estimate the cost of miscellaneous hardware and accessories.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of miscellaneous hardware and accessories.

   A. List miscellaneous hardware not covered in other headings of the estimate such as metal foundation pieces, wall ventilators, roof ventilators, access doors, mail boxes, etc.
   B. Determine cost of items listed.
   C. Estimate labor to install items listed.
   D. Total all the materials used in carpentry and millwork estimates, (bm).
   E. Obtain hardware allowance by multiplying 30 pounds of nails per 1000 feet b.m. of lumber.
   F. Cost of hardware allowance is determined by calculating the cost of the nails, (pounds x unit cost).
   G. Tabulate all costs.

II. Students estimate cost of miscellaneous hardware and accessories.

CONTENT TITLE: Overhead and Profit

SUB OBJECTIVE 33: The student will demonstrate ability to estimate overhead costs and profit incurred in the construction of a frame building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates an overhead and profit estimate.

   A. Calculate the overhead percent.
   B. Determine amount of overhead to be added (total cost x percent).
   C. Add profit (total cost x percent of profit).

II. Students estimate overhead and profit allowance in the construction of a frame building.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to estimate the cost of labor and material required to build a small commercial building comprised of concrete foundation, concrete block walls and partitions, wall bearing steel joists, with a built-up tar and gravel roof on a steel deck and an aluminum storefront.

SOURCES OF INFORMATION

Building Construction Estimating, (Frank R. Walker Co., McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020), 1971.

Cooper and Badzinski, Carpentry in Residential Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Manufacturer's literature and pricing sheets
- Drawing check sheets or matrix charts
- Student Resource Manual

CONTENT TITLE: Earthwork

SUB OBJECTIVE 34: The student will demonstrate ability to estimate the grading and excavation work for a commercial building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating cost of grading and excavation.

A. Obtain cost of bulldozer rental (hourly) with operator.
B. Estimate bulldozer hours needed (from tables).
C. Calculate cost of grading and excavation (hours x rate).
D. Estimate cost of removing excess earth.
E. Tabulate results.

II. Students estimate cost of grading and excavation.

CONTENT TITLE: Concrete

SUB OBJECTIVE 35: The student will demonstrate ability to estimate cost of concrete work for a commercial building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of concrete work for a commercial building. Estimations will include:

A. Material cost of forms.
B. Labor cost to assemble forms.
C. Material cost of bed.
D. Labor cost to spread and compact bed.
E. Material cost of ready-mix concrete.
F. Labor cost to place and float concrete.
G. Tabulation of results.

II. Students estimate the cost of concrete work for a commercial building.

CONTENT TITLE: Masonry Walls

SUB OBJECTIVE 36: The student will demonstrate ability to estimate the cost of labor and material to erect the concrete masonry walls and partitions of a commercial building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating concrete masonry walls of a commercial building.

A. Determine area of exterior masonry walls.
B. From tables, estimate number of masonry units needed, mortar requirements and labor to erect exterior masonry walls.
C. Determine area of interior masonry partitions.
D. From tables, estimate number of masonry units needed, mortar requirements and labor to erect interior masonry walls.
E. Determine price of masonry units and mortar.
F. Tabulate results.

II. Students estimate the cost of labor and materials to erect concrete masonry walls and partitions.

CONTENT TITLE: Structural Steel

SUB OBJECTIVE 37: The student will demonstrate ability to estimate the cost of structural steel required for a small commercial building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates a structural and miscellaneous steel estimate.

A. Determine weight of steel joists from brochures furnished by joist manufacturers.
B. Calculate cost of joists and accessories.
C. Estimate labor to erect joists and accessories.
D. Tabulate results.

II. Students estimate cost of structural steel.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Built-up Roofs

SUB OBJECTIVE 38: The student will demonstrate ability to estimate the labor and materials required to erect a built-up roof on steel roof deck.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of labor and material to erect a built-up roof on steel roof deck.

   A. Determine area of roof to be erected.
   B. Calculate cost of roof deck material.
   C. Estimate labor to erect roof deck material from table (including waste).
   D. Determine quantity of built-up roofing required from the tables.
   E. Estimate labor to apply built-up roofing.
   F. Determine number of roof vents needed.
   G. Estimate cost of roof vents.
   H. Tabulate results.

II. Students estimate labor and materials required to erect a built-up roof on steel roof decking.

CONTENT TITLE: Aluminum Storefront

SUB OBJECTIVE 39: The student will demonstrate ability to estimate the labor and materials required to erect an aluminum storefront.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the labor and materials to erect an aluminum storefront.

   A. Determine linear feet of each class of metal sections required to erect the front.
   B. Calculate cost of material for front.
   C. Estimate labor required for erection of storefront, (use tables).
   D. Tabulate results.

II. Students estimate the labor and materials to erect an aluminum storefront.

CONTENT TITLE: Storefront Glazing

SUB OBJECTIVE 40: The student will demonstrate ability to estimate the labor and materials required to glaze a storefront and hang windows and doors.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the materials and labor to glaze a storefront and set windows and doors. Estimations will include:

   A. Quantity of glass required for front.
   B. Labor to set plate glass in storefront from tables.
   C. Material cost of other windows and doors, complete.
   D. Labor to set doors and windows.
   E. Tabulation of results.

II. Students estimate the labor and materials to glaze a storefront and set windows and doors.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Commercial Millwork

SUB OBJECTIVE 41: The student will demonstrate ability to estimate the millwork on a commercial building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the millwork for a commercial building. Estimations will include:

   A. Cost of wood base.
   B. Cost of picture molding.
   C. Cost of interior window trim, if any.
   D. Cost of wood paneling, if any.
   E. Closet shelving and rods, if any.
   F. Cost of wood cabinets, if any.
   G. Tabulation of results.

II. Students estimate cost of millwork for a commercial building.

TENT TITLE: Plaster

S B OBJECTIVE 42: The student will demonstrate ability to estimate the cost of labor and materials required to finish walls in a commercial building with plaster.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the room-finish for a commercial building. Estimations will include:

A. Area of walls to be plastered.
B. Material requirements for plaster (from tables).
C. Labor to apply plaster (from tables).
D. Area of ceilings to be installed.
E. Runner channels, cross-furring channels, metal lath and accessory requirements (from charts).
F. Labor cost to install lathing.
G. Material cost for ceiling plaster (from tables).
H. Labor cost to plaster ceilings (from tables).
I. Tabulation of results.

II. Students estimate the cost of labor and materials for a plaster finish in a commercial building.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Paint

SUB OBJECTIVE 43: The student will demonstrate ability to estimate the material and labor costs for a commercial building paint job.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the painting for a commercial building. Estimations will include:

A. Area of exterior painting work required.
B. Material cost of exterior painting (from tables).
C. Labor cost.
D. Area of interior painting required.
E. Material cost of interior painting (from tables).
F. Labor cost of interior painting (from tables).
G. Area of interior trim and cabinets to be painted.
H. Material cost of interior trim and cabint painting (from tables).
I. Tabulation of results.

II. Students estimate cost of painting the interior and exterior of a commercial building.

CONTENT TITLE: Wiring

SUB OBJECTIVE 44: The student will demonstrate ability to estimate the cost of wiring a commercial building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of electrical wiring for a commercial building. Estimations will include:

   A. Cost of service entrance.
   B. Cost of conduits.
   C. Cost of wire.
   D. Cost of switches and receptacles.
   E. Cost of fluorescent light fixtures.
   F. Tabulation of results.

II. Students estimate the cost of the electrical wiring for a commercial building.

CONTENT TITLE: Plumbing

SUB OBJECTIVE 45: The student will demonstrate ability to estimate the cost of plumbing a commercial building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of plumbing for a commercial building. Estimations will include:

   A. Cost of fixtures.
   B. Cost of pipe and fittings.
   C. Rough-in labor.
   D. Cost to place fixtures.
   E. Cost of sewer pipe (materials and labor).
   F. Tabulation of results.

II. Students estimate cost of plumbing for a commercial building.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Air Conditioning and Heating

SUB OBJECTIVE 46: The student will demonstrate ability to estimate the cost of heating and air conditioning a commercial building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of a heating and air conditioning system for a commercial building. Estimations will include:

A. Volume of space to be air conditioned.
B. Size of unit needed.
C. Cost of unit and set up labor.
D. Cost of duct systems.
E. Cost of diffusers, intakes, grilles, etc.
F. Cost of insulating ducts.
G. Cost of electrical work.
H. Cost of balancing system.
I. Tabulation of results.

II. Students estimate cost of heating and air conditioning system for a commercial building.

CONTENT TITLE: Profit and Overhead

SUB OBJECTIVE 47: The student will demonstrate ability to calculate the profit and overhead allowance for the construction of a commercial building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating profit and overhead allowance for a commercial building.

   A. Determine amount to be added to offset overhead expenses (a percentage of the total contract).
   B. Determine profit margin desired.
   C. Tabulate results.

II. The student estimates the profit and overhead allowance for construction of a commercial building.

CONTENT TITLE: Recaps and Summaries

SUB OBJECTIVE 48: The student will demonstrate ability to prepare a Recap and Summary Sheet.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing an estimate recapitulation (Recap) and Summary Sheet.

   A. Copy total quantities from quantity takeoff.
   B. List unit price and total price of labor and material for each item of construction.
   C. Add totals for complete estimate (Recap).
   D. Copy totals from Recap for each item of construction.
   E. Add sum of all items for total estimate (Summary Sheet).

II. Students prepare a Recap and Summary Sheet.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to estimate the costs of remodeling work on a residential building.

SOURCES OF INFORMATION

Building Construction Estimating, (Frank R. Walker Co., McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020), 1971.

Cooper and Badzinski, Carpentry in Residential Construction, (Prentice Hall: Englewood Cliffs, New Jersey 07632), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- General review of math requirements for additional training or job placement

Science

- General review of science requirements for additional training or job placement

Communication Skills

- Technical literature
- Student Resource Manual
- Material pricing sheets
- Review of career opportunities
- Review of post-secondary training available
- Looking for, getting and holding a job

CONTENT TITLE: Masonry Repairs

SUB OBJECTIVE 49: The student will demonstrate ability to estimate the cost of masonry repairs on a remodeling job.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating masonry repairs for remodeling work. Estimations will include:

   A. Area of masonry work to be patched.
   B. Labor cost to remove and chip brick.
   C. Cost of material to patch masonry.
   D. Labor cost to patch masonry.
   E. Cost of cleaning and painting face brick.
   F. Tabulation of results.

II. Students estimate the cost of masonry repairs for remodeling work.

CONTENT TITLE: Caulking and Weather stripping

SUB OBJECTIVE 50: The student will demonstrate ability to estimate the cost of caulking and weather stripping on a remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of caulking and weather stripping a remodeling project. Estimations will include:

A. Linear feet of caulking required for job.
B. Cost of caulking material.
C. Labor cost of caulking.
D. Cost of replacing fascia boards (labor and material).
E. Linear feet of weather stripping required.
F. Cost of weather stripping material.
G. Cost of weather stripping labor.
H. Tabulation of results.

II. Students estimate caulking and weather stripping costs for a remodeling job.

CONTENT TITLE: Reglazing

SUB OBJECTIVE 51: The student will demonstrate ability to estimate the cost of reglazing on a residential re-remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating cost of reglazing for a remodeling project. Estimations will include:

A. Amount of glass to be replaced.
B. Cost of materials, glass, glazing compounds and glazing chips.
C. Cost of labor to replace glass.
D. Tabulation of results.

II. Students estimate cost of reglazing for a remodeling project.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Roof Repair

SUB OBJECTIVE 52: The student will demonstrate ability to estimate the cost of roof repairs on a remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of roof repairs for a remodeling project. Estimations will include:

A. Area of roof to be replaced.
B. Cost of removing old roofing.
C. Labor cost of installing a new shingle roof.
D. Labor cost to replace metal gutters.
E. Cost of materials for roofing and gutter.
F. Tabulation of results.

II. Students estimate the cost of roof repairs for a remodeling project.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Windows and Doors

SUB OBJECTIVE 53: The student will demonstrate ability to estimate the cost of replacing windows and doors on a remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of replacing windows and doors for a remodeling project. Estimations will include:

A. Number of screen doors to be replaced.
B. Number of window screens to be replaced.
C. Material cost of screen doors.
D. Material cost of window screens.
E. Labor cost to install screen doors.
F. Labor cost to install window screens.
G. Material cost of replacing garage door, if required.
H. Labor cost to replace garage door, if required.
I. Number of windows to be replaced.
J. Number of doors to be replaced.
K. Material cost to replace windows and trim.
L. Material cost to replace doors and trim.
M. Labor cost to replace the windows and trim.
N. Labor cost to replace the doors and trim.
O. Tabulation of results.

II. Students estimate the cost of replacing windows and doors in a remodeling project.

CONTENT TITLE: Replastering

SUB OBJECTIVE 54: The student will demonstrate ability to estimate the cost of replastering the ceilings and walls on a remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of replastering ceilings and walls of a remodeling project. Estimation will include:

   A. Area of plaster to be replaced in ceilings and walls.
   B. Labor to strip old plaster from walls and ceilings.
   C. Cost of material to replaster walls and ceilings.
   D. Labor cost to replaster walls and ceilings from tables.
   E. Tabulation of results.

II. Students estimate the cost of replastering ceilings and walls of a remodeling project.

CONTENT TITLE: Resurfacing Floors

SUB OBJECTIVE 55: The student will demonstrate ability to estimate the cost of resurfacing floors on a remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of resurfacing the floors in a remodeling project. Estimations will include:

   A. Area of floor to be resurfaced.
   B. Labor required to sand the floors.
   C. Installed cost of new finished flooring from tables.
   D. Tabulation of results.

II. Students estimate the cost of resurfacing the floors in a remodeling project.

CONTENT TITLE: Wood Trim Replacement

SUB OBJECTIVE 56: The student will demonstrate ability to estimate the cost of replacing the wood trim on a remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of replacing wood trim in a remodeling project. Estimations will include:

A. Linear feet of trim to be replaced.
B. Labor cost to remove existing trim.
C. Material cost of new trim.
D. Labor to place new trim (from tables).
E. Tabulation of results.

II. Students estimate the cost of replacing trim in a remodeling project.

CONTENT TITLE: Kitchen Cabinets

SUB OBJECTIVE 57: The student will demonstrate ability to estimate the cost of replacing the kitchen cabinets with factory assembled and finished units on a remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of replacing kitchen cabinets with factory assembled and finished units. Estimations will include:

A. Cost of removing old cabinets.
B. Material cost of new cabinets from supplier.
C. Labor cost to set new cabinets.
D. Tabulation of results.

II. Students estimate the cost of replacing the kitchen cabinets with factory assembled and finished units.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Hardware

SUB OBJECTIVE 58: The student will demonstrate ability to estimate the cost of finish hardware required on a remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of finish hardware for a remodeling project. Estimations will include:

   A. Amount of hardware to be replaced or furnished.
   B. Material cost of hardware from local supplier.
   C. Labor cost of setting new hardware (from tables).
   D. Tabulation of results.

II. Students estimate cost of the finish hardware for a remodeling project.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Repainting

SUB OBJECTIVE 59: The student will demonstrate ability to estimate the cost of painting on a remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of painting for a remodeling project. Estimations will include:

A. Area of exterior painting involved.
B. Labor cost of removing old paint, (if required).
C. Labor cost of applying prime coat.
D. Time and labor cost of two coats of paint for exterior siding.
E. Material cost of exterior paint and primer (from tables).
F. Area of interior painting involved.
G. Cost of washing or removing the old paint, if required, (from tables).
H. Material cost of the interior paint (from tables).
I. Labor cost of the interior repainting.
J. Tabulation of results.

II. Students estimate cost of painting for a remodeling project.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Plumbing Fixtures

SUB OBJECTIVE 60: The student will demonstrate ability to estimate the cost of replacing existing plumbing fixtures on a remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating the cost of replacing plumbing fixtures in a remodeling project. Estimations will include:

   A. Which fixtures are to be replaced.
   B. Material cost of fixtures to be replaced.
   C. Labor cost of replacing fixtures (from tables). Cost of removing old fixtures is included.
   D. Tabulation of results.

II. Students estimate the cost of replacing existing fixtures in a remodeling project.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Rewiring

SUB OBJECTIVE 61: The student will demonstrate ability to estimate the cost of rewiring a remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating cost of rewiring a remodeling project. Estimations will include:

   A. Amount of wiring to be replaced.
   B. Number of outlets and switches to be added.
   C. Appliances to be added.
   D. Material cost of new wire.
   E. Material cost of outlets and switches.
   F. Material cost of appliances to be installed.
   G. Labor cost to pull wire in existing conduits.
   H. Labor to add new outlets, switches and appliances (from tables).
   I. Tabulation of results.

II. Students estimate the cost of rewiring a remodeling project.

CONTENT TITLE: Cleanup

SUB OBJECTIVE 62: The student will demonstrate ability to estimate the cost of cleanup, profit and overhead required on remodeling project.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates estimating cleanup, profit and overhead for a remodeling project. Estimations will include:

   A. Labor cost required for cleanup operations.
   B. Amount to be added to offset overhead expense (taken as percent of total job costs).
   C. Margin of profit desired.
   D. Tabulation of results.

II. Students estimate the cost of cleanup, profit and overhead for a remodeling project.

CONTENT TITLE: Recaps and Summaries

SUB OBJECTIVE 63: The student will demonstrate ability to prepare a Recap and Summary Sheet.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing an estimate recapitulation (Recap) and Summary Sheet.

   A. Copy the total quantities from quantity takeoff.
   B. List unit price and total price of labor and material for each item of construction.
   C. Add totals for complete estimate (Recap).
   D. Copy totals from Recap for each item of construction.
   E. Add sum of items for a total estimate (Summary Sheet).

II. Students prepare a Recap and Summary Sheet.

EXPEDITING AND SCHEDULING

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ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to prepare a critical path diagram for a small residential construction project -- i.e., a frame garage.

SOURCES OF INFORMATION

Cooper, George H. and Stanely Badzinski, Building Construction Estimating. 3rd ed., (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1971.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Basic math computations
- Percentages
- PERT charts, graphs and tables
- Estimations

Communication Skills

- Student Resource Manual
- Vocabulary development
- Technical literature

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Expediting Critical Path Diagrams

SUB OBJECTIVE 1: The student will demonstrate ability to order the sequence of events on a residence.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates listing the sequence of events in constructing a frame garage.

A. Refer to the project estimate to determine which jobs are necessary to complete the project.

B. List the activities in the order in which they occur -- excavating, concrete foundations, plumbing, wall framing, roof framing, trusses, wall sheathing, siding, roofing, wiring, painting and cleanup.

C. Define those activities which can be done simultaneously with others. For instance: Plumbing and concrete work; trussing and wall framing; wall sheathing and roof sheathing; roofing, wiring and siding; painting and cleanup.

II Students list sequence of events in constructing a frame garage.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Expediting - Preparing Critical Path Diagrams

SUB OBJECTIVE 2: The student will demonstrate ability to prepare a critical path network and determine EET, EST, EFT, LST, LFT, TF and FF.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing a critical path network and determining EET, EST, EFT, LST, LFT, TF and FF.

A. Take the project list and connect the activities with a line running from start to finish.

B. Number the events.

C. Determine the duration of each activitiy from the project time-cost estimates.

D. Begin with the first activity and determine the Earliest Starting Time and Earliest Finish Time for each activity. (The EST, or Earliest Starting Time, for an event is the total duration of all preceding events. The EFT, or Earliest Finish Time, of an event is the EST plus duration of the event itself. The EET, or Earliest Event Time, is the earliest time of an event's occurrence.)

E. Calculate the Free Float (FF) of a project. (FF = EET - EFT). This is the amount of leeway a given job has before it begins to hold up the project as a whole.

F. Calculate the Latest Finish Time for a project from the project contract.

G. Subtract the duration of the last task from the Latest Finish Time; the result is the Latest Starting Time (LST) for that activity. Work backward using this procedure to determine the Latest Starting Time for each activity in the project.

H. Determine the Total Float of each event by the formula: TF = LST - EST. (Any activity in which TF = 0 is on the critical path.)

II. Students prepare a critical path network and determine EET, EST, EFT, LST, LFT, TF and FF.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to construct a job progress bar chart to estimate percentages of time and expense involved in each segment of a construction project and to reschedule parts of project which are off schedule.

SOURCES OF INFORMATION

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Time lines and sequencing
- Review of math requirements for job entry and/or higher education

Communication Skills

- Technical literature
- Student Resource Manual
- Review of communication skills required for job entry and/or higher education
- Review of job and career opportunities
  - Job
  - Junior colleges and technical schools
  - Four-year colleges

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Bar Charts

SUB OBJECTIVE 3: The student will demonstrate ability to calculate the percentage of total cost of each particular job in a project and to make a chart showing order of work, cost of each job, estimated time and percentage of total job.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates calculating percentage of total cost of each particular job in a project and making a chart showing order of work, job cost, estimated time and percentage of total job.

   A. List the activities of the project in the order in which they occur.
   B. List the expected cost of each job in the project.
   C. List the amount of time each part of the job should take.
   D. Divide the cost of each job by the total project cost to find the percentage of the total.
   E. List the calculated percentages.

II. Students make a chart.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Bar Charts

SUB OBJECTIVE 4: The student will prepare a bar graph showing expected progress on a job as opposed to actual progress on the job.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing bar graph showing expected and actual job progress.

A. Take a sheet of graph paper and list the tasks involved in the project in the order in which they occur.
B. Block out the number of days required to finish the first task.
C. Skip several rows and the number of blocks representing days until the second task is begun.
D. Block out the number of days required to finish the second task.
E. Continue this process until the last task is blocked in.
F. Use this chart to contact subcontractors and suppliers in order to schedule the delivery of men and materials to the project.
G. As the project progresses use a different colored pencil to block in, underneath the first set of blocks, the progress of the job.
H. If the project becomes seriously off schedule, contact the subcontractors and suppliers to reschedule their deliveries.

II. Students prepare bar graph showing expected and actual job progress.

SURVEYING

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ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to use a transit, tape, wood stakes and other tools to determine the error, if any, in an existing football field.

SOURCES OF INFORMATION

Department of the Army, Elements of Surveying, 1971. (Order from GPO, Number D101.11: 5-232/3 TM5-232). Listed as Army II.

Department of the Army, Topographic Surveying, 1953. (Order from GPO, Number D101.11: TM5-234).

Brinker, Russell C., Elementary Surveying, (International Textbook Co., Division of Intext Educational Publishers: Scranton, Pennsylvania 18515), 1969.

Kissam, Phillip, Surveying Practice, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1971.

Spier, R. F., Surveying and Mapping: A Manual of Simplified Techniques, (Holt, Rinehart and Winston, Inc.: 383 Madison Avenue, New York, New York 10017), 1970.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Level and plumb
- Degrees and angles
- Linear measurements
  - Whole numbers
  - Fractions
  - Decimals

Communication Skills

- Manufacturer's literature
- Vocabulary development
- Student Resource Manual

CONTENT TITLE: Basic Operations

SUB OBJECTIVE 1: The student will demonstrate ability to set up a transit over a temporary bench mark, align the pins and turn an angle.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates setting up the transit over a point.

A. Extend tripod.
B. Mount instrument.
C. Attach plumb bob.
D. Center instrument over temporary bench mark.
E. Level instrument.
F. Align pins using vertical hairline.
G. Turn angle and read vernier.

II. Students set up a transit.

CONTENT TITLE: Basic Operations

SUB OBJECTIVE 2: The student will demonstrate ability to measure a straight line using tape, chaining pins, wood stakes and transit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates measuring a straight line.

A. Set up transit.
B. Hold tape.
C. Tension tape.
D. Set and count pins.
E. Stake the line.

II. Student measures a straight line.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Basic Operations

SUB OBJECTIVE 3: The student will demonstrate ability to measure distances by pacing.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates measuring by pacing.

A. Measure playing length of football field (300 ft.).
B. Pace playing length of field and back (600 ft.) counting paces.
C. Divide 600 ft. by number of paces to obtain average value of pace.
D. Step off 100 ft. and check with tape to determine accuracy of pacing distances.

II. Student measures by pacing.

CONTENT TITLE: Basic Operations

SUB OBJECTIVE 4: The student will demonstrate ability to check existing football fields and determine the error (if any) in the present layout.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor checks layout of present football field and determines error (if any) in construction.

A. Set stakes.
B. Measure lines.
C. Turn angles.
D. Mark points.
E. Determine error of closure.

II. Student reruns football field layout and determines error (if any) in construction.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to check and adjust surveying tapes, dumpy levels and transits.

SOURCES OF INFORMATION

Department of the Army, Elements of Surveying, 1971. (Order from GPO, Number D101.11: 5-232/3 TM5-232). Listed as Army II.

Department of the Army, Topographic Surveying, 1953. (Order from GPO, Number D101.11: TM5-234).

Brinker, Russell C., Elementary Surveying, (International Textbook Co., Division of Intext Educational Publishers: Scranton, Pennsylvania 18515), 1969.

Kissam, Phillip, Surveying Practice, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1971.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Degrees, minutes and seconds
- Elevation measurements

Science

- Magnetic directions
- Topography and contours

Communication Skills

- Introduction to field notes
- Interpretation of survey maps
- Manufacturer's literature

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Tapes

SUB OBJECTIVE 5: The student will demonstrate ability to check tape for length and adjust measurements taken with a tape of incorrect length.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses care of tapes.

II. Instructor demonstrates checking a tape for length and adjusting measurements taken with a tape of incorrect length.

A. Compare tape with a standardized tape which has been tested by the National Bureau of Standards.

B. Apply correction factor to measured length to obtain true length.

III. Student checks tape for length and adjusts measurements taken with a tape of incorrect length.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Adjusting the Dumpy Level

SUB OBJECTIVE 6: The student will demonstrate ability to check and adjust the plate level bubble of a dumpy level.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses use and care of telescopes, capstan nuts and leveling screws.

II. Instructor demonstrates checking and adjusting the level bubble of a dumpy level.

A. Set up the level and center the bubble.
B. Revolve telescope 180°. (The distance the bubble moves off center is double the error.)
C. Turn capstan nut at one end of the level vial to move the bubble half way back to the centered position.
D. Level instrument again.
E. Repeat the test until bubble remains centered during a complete revolution of telescope.

III. Student checks and adjusts the level bubble of a dumpy level.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Adjusting the Dumpy Level

SUB OBJECTIVE 7: The student will demonstrate ability to adjust the horizontal cross hair of a dumpy level.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses use and care of reticle and capstan screws.

II. Instructor demonstrates adjusting the horizontal cross hair of a dumpy level.

A. Set up level.
B. Sight a sharp defined point with one end of cross hair.
C. Turn telescope so that horizontal cross hair moves across point. If cross hair does not remain on point, the instrument is out of adjustment.
D. Loosen capstan screws holding reticle and rotate until the hair is positioned where it will remain on the point as the telescope is revolved.

III. Student adjusts horizontal cross hair on a dumpy level.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Adjusting the Dumpy Level

SUB OBJECTIVE 8: The student will demonstrate ability to check and adjust the line of sight of a dumpy level.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses use and care of telescope, capstan screws and leveling rods.

II. Instructor demonstrates the peg adjustment for checking and adjusting the line of sight of a dumpy level.

A. Drive two stakes about 300 ft. apart. (A football field is handy for this exercise.)
B. Set up the instrument half way between the points. (Fifty yard line.)
C. Take rod readings on each of the stakes and compute difference in elevation.
D. Set up instrument very close to one of the points, (A).
E. Take reading with eyepiece only a few inches from rod at point A. (Usually a pencil is held by a rodman and the reading is taken by sighting through the objective lens.)
F. Add reading to difference in elevation to determine what he should read on the rod at other point (B). If he does not read this number, the instrument is not in adjustment.
G. Adjust instrument by loosening upper or lower capstan screw and loosen lower or upper screw until horizontal cross hair gives desired reading.
H. Repeat test until an exact setting is obtained.

III. Students adjust the line of sight of a dumpy level using peg adjustment method.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Adjusting the Dumpy Level

SUB OBJECTIVE 9: The student will demonstrate ability to check and adjust a dumpy level.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates checking and marking adjustments on a dumpy level.

   A. Adjust level bubble.
   B. Adjust horizontal cross hair.
   C. Line of sight using peg adjustment.
   D. Check previous adjustments and repeat as necessary.

II. Student checks and adjusts a dumpy level.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Adjusting the Transit

SUB OBJECTIVE 10: The student will demonstrate ability to adjust the plate level vials on a transit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the use and care of transits, plate level vials and capstan screws.

II. Instructor demonstrates adjusting the plate level vials on a transit.

A. Set up instrument.
B. Bring one vial over two opposite leveling screws and center bubble.
C. Rotate instrument 180°. If bubble is not centered, the instrument is out of adjustment.
D. Turn capstan screws of one end of vial to move bubble halfway back to centered position.
E. Level instrument.
F. Repeat test until bubble remains centered.
G. Adjust other bubble in similar manner.

III. Student adjusts plate level vials on a transit.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Adjusting the Transit

SUB OBJECTIVE 11: The student will demonstrate ability to adjust the vertical cross hair of a transit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates adjusting the vertical cross hair of a transit.

A. Set up and level transit.
B. Backsight on well-defined point (point A).
C. Plunge telescope and set a well-defined foresight point (point B) at least 600 ft. away if possible.
D. Turn instrument 180° back to point A with telescope still inverted.
E. Plunge telescope back to original position, and if point B is missed, the instrument is out of adjustment.
F. Adjust vertical hair one fourth of the distance that the two minus points (B) miss by loosening one of the side capstan nuts and tightening the other.
G. Repeat test until telescope sights same point B after reversing from backsight A.

II. Students adjust vertical cross hair of a transit.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Adjusting the Transit

SUB OBJECTIVE 12: The student will demonstrate ability to adjust the horizontal cross hair of a transit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the adjustment of a horizontal cross hair of a transit.

A. Set up and level instrument.
B. Line up on two stakes: One stake about 5 to 10 feet from instrument, the other about 300 feet from instrument.
C. Take readings first at near stake, then at far stake.
D. Plunge telescope and sights on near stake, setting horizontal hairline on first rod reading. Then read rod at far stake. If reading on far stake is not the same as first reading on far stake, instrument is out of adjustment.
E. Set hairline at point halfway between readings on far stake using top and bottom capstan screws.
F. Repeat test until readings are similar.

II. Students adjust horizontal cross hair of a transit.

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ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Adjusting the Transit

SUB OBJECTIVE 13: The student will demonstrate ability to adjust the standards of a transit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates adjusting standards on a transit.

A. Set up and carefully level transit.
B. Sight a well-defined high point at a vertical angle of at least 30°.
C. Clamp plates, depress telescope and mark a point near the ground.
D. Plunge telescope and sight high point again.
E. Clamp plates and depress telescope. If it does not come to the same point near the ground, instrument is out of adjustment.
F. Set a point halfway between low points and sight on it.
G. Clamp plates, elevate telescope and bring line of sight back to high point by raising or lowering movable block in one standard. Block is raised or lowered by adjusting top and bottom screws in each standard.
H. Repeat test until points remain in line of sight with telescope in normal and inverted positions.

II. Student adjusts standards on a transit.

CONTENT TITLE: Adjusting the Transit

SUB OBJECTIVE 14: The student will demonstrate ability to adjust the telescope level vial on a transit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates adjusting the telescope level vial on a transit.

   A. Use peg method to verify necessity for adjustment.
   B. Make adjustment, if necessary, by putting horizontal hairline on required reading and centering telescope bubble by turning capstan screws at one end of level vial.

II. Student adjusts a telescope level vial on a transit.

CONTENT TITLE: Adjusting the Transit

SUB OBJECTIVE 15: The student will demonstrate ability to adjust the vertical circle vernier on a transit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates adjusting the vertical circle vernier of a transit (make index error zero).

   A. Level instrument.
   B. Center telescope level.
   C. Loosen capstan screws holding vernier plate and move it to make zero marks of the vernier and vertical circle coincide.

II. Student demonstrates the adjustment of the vertical circle vernier on a transit.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Adjusting the Transit

SUB OBJECTIVE 16: The student will demonstrate ability to check and adjust a transit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates checking and adjusting a transit. Adjustments include:

   A. Plate level vials.
   B. Vertical cross hair.
   C. Horizontal cross hair.
   D. Standards.
   E. Telescope level vial.
   F. Vertical circle vernier.

II. Student checks and adjusts a transit.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to perform accurate route surveys for a two lane highway, surveying straight lines and laying out both vertical and horizontal curves.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, 1964. (Order from GPO, Number D101.11: 5-233/2 TM5-233). Listed as Army III.

Brinker, Russell C., Elementary Surveying, (International Textbook Co., Division of Intext Educational Publishers: Scranton, Pennsylvania 18515), 1969.

Pafford, F. William, Handbook of Survey Notekeeping, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1962.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Computations of whole numbers and decimals
- Plotting charts, graphs and profiles
- Scale numbers
- Ratios and proportions

Communication Skills

- Student Resource Manual
- Professional lettering
- Field note writing
- Rough drawings
- Blueprint reading

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Route Profiles

SUB OBJECTIVE 17: The student will demonstrate ability to survey a route profile using level, tape, wood stakes and other tools.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates surveying a route profile.

A. Set wood stakes at 100' stations (or 25' stations if desirable) along center line of route.

B. Set up level at convenient point on right-of-way so that sights will be approximately uniform.

C. Take back sight (+ sight) to point of known elevation (bench mark).

D. Obtain H.I. (height of instrument) by adding (+) sight to known elevation of B.M.

E. Take intermediate readings (- sights) at all stations angle points (points marking change of direction), breaks in ground elevations and at critical points (bridges, culverts, roads, etc.).

F. Select a turning point (T.P.) so that (+ sight) and (- sight) will be approximately equal and move instrument to another position, repeating the process until all shots are taken. Ground shots are taken to tenths and pavement shots (curbs, roadways, sidewalks, etc.) are taken to hundredths.

G. Maintain proper field notes.

II. Students survey a route profile.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Computing Elevations

SUB OBJECTIVE 18: The student will demonstrate ability to compute elevations from readings taken in field.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates computing elevations from field notes.

A. Determine height of instrument (H.I.) by adding back sight (+ sight) to known elevation of bench mark (B.M.).
B. Subtract intermediate readings (station point readings) from H.I. to obtain station elevations.
C. Take (+ sights and - sights) at turn points (TP) when placement of instrument is changed.
D. Enter elevations in notes.

II. Student computes elevations from field notes.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Plotting Profile Surveys

SUB OBJECTIVE 19: The student will demonstrate ability to plot a profile survey from data generated by field calculations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates plotting a profile survey from data obtained from field notes.

A. Plot points on Plate A profile paper.
B. Use 10 to 1 scale exaggeration (if horizontal scale is 1" = 40', then vertical scale is 1" = 40').
C. Plot elevations and stations on profile paper noting horizontal and vertical scale.
D. Connect plotted elevations with curves.
E. Select a grade which will keep the cuts and fills somewhat equal. Ascending grades are (+) and descending grades are (-).
F. Draw in grade line.
G. Letter in all pertinent information.

II. Student plots a profile from field note data.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Cross Section Leveling

SUB OBJECTIVE 20: The student will demonstrate ability to perform cross section leveling using level, tape and other tools.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses care of levels, tapes and other tools.

II. Instructor demonstrates cross section leveling.

A. Set up level at convenient point on right of way so that sights will be approximately uniform.
B. Take (+ sight) to point of known elevation for H.I.
C. Take (- sights) along cross section line of I station (cross section line is at right angles to center line of road) at each ground elevation break. The cross section line runs from right-of-way line to right-of-way line.
D. Measure distance from point of shot to center line of road by pacing.
E. Similarly take (- sights) at ground elevation breaks at 2 station, 3 station, etc., establishing turning points (T.P.) if needed.

III. Student performs cross section leveling.

CONTENT TITLE: Preparing Field Notes

SUB OBJECTIVE 21: The student will demonstrate ability to prepare field notes for a cross section survey.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates taking field notes for a cross section survey.

A. Record station number, (+ sight), H.I., (- sight), elevation of T.P.

B. On right side of notebook, record (- sight) of center line then show (- sight) as numerator and distance from center line as denominator for all shots taken; indicate by position in notes whether on left or right side of road center line.

II. Student makes field notes for cross section survey.

CONTENT TITLE: Computing Volumes of Earthwork

SUB OBJECTIVE 22: The student will demonstrate ability to compute volume of cut and fill earthwork.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the computation of cut and fill earthwork volume.

A. Compute cross section area at station 1 using 1 to 1 side slope ratio for cuts and 1 to 1-1/2 side slope ratio for fills.

B. Compute cross section area at station 2.

C. Obtain the average area by adding area of station 1 to area of station 2 and dividing by 2.

D. Multiply this average by the interval between the stations to obtain volume.

E. Repeat the process using stations 2 and 3, 3 and 4, etc.

II. Student computes cut and fill earthwork.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to locate, survey and rerun existing surveys, following existing deed descriptions where necessary, for enclosed areas of property. In addition, the student will compute and stake out a sewer line on such property.

SOURCES OF INFORMATION

Department of the Army, Elements of Surveying, 1971. (Order from GPO, Number D101.11: 5-232/3 TM5-232). Listed as Army 11.

Brinker, Russell C., Elementary Surveying, (International Textbook Co., Division of Intext Educational Publishers: Scranton, Pennsylvania 18515), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Formula computations
- Triangulation
- Developing grids and stations for stake information

Communication Skills

- Vocabulary development
- Student Resource Manual
- Reading and interpreting legal descriptions (metes and bounds)
- Related safety information

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: City Lots

SUB OBJECTIVE 23: The student will demonstrate ability to locate and survey a city lot.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates how to locate and survey a city lot.

A. Obtain record from City Clerk's (or county clerk's) office.
B. Locate property on the ground.
C. Run a closed traverse occupying all corners, if possible.
D. Set a monument at each corner.

II. Student locates and surveys a city lot.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Rerunning Existing Surveys

SUB OBJECTIVE 24: The student will demonstrate ability to rerun existing survey and compute the area of enclosed property.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates rerunning an existing survey and computing the area of enclosed property.

A. Secure description and map of area from county clerk's office.
B. Convert all old compass bearings to true bearings.
C. Convert any lengths given in rods, chains, poles, varas, etc., to feet and decimals of a foot.
D. Follow metes and bounds and old map in relocating existing monuments or replacing obliterated or lost corners.
E. Prepare map of area.
F. Divide area into triangles to compute area.
G. Compute area using formula: $A = \sqrt{s(s-a)(s-b)(s-c)}$

Where:
A = area
a = 1st side of triangle
b = 2nd side of triangle
c = 3rd side of triangle
$s = 1/2(a + b + c)$.

II. Student reruns an existing survey and computes the area of enclosed property.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Sewer Lines

SUB OBJECTIVE 25: The student will demonstrate ability to compute and stake out a sewer line.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates computing and staking out a sewer line.

A. Run profile of ground where line is to be laid.
B. Establish gradient of slope (grade).
C. Set station stakes (50' intervals).
D. Set up instrument at convenient spot and obtain H.I. (height of instrument) by back-sighting to a point of known elevation.
E. Calculate the grade rod for each station by subtracting grade elevation (obtained from profile) from H.I.
F. Take ground shots at each station to obtain ground rod.
G. Compute cut or fill at each station by subtracting ground rod from grade rod.
H. Mark station stakes with station number and amount of cut or fill.
I. Set target at proper reading on rod so that base of rod is at grade or at an even number of feet above or below grade.
J. Drive stakes to depth so that horizontal cross hair coincides with center line of target offsetting stakes from center of pipe line so they will not be disturbed during construction.

II. Student computes and stakes out a sewer line.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to use transit, tape, wood stakes and other equipment to run a closed angle traverse and map an enclosed area.

SOURCES OF INFORMATION

Department of the Army, Elements of Surveying, 1971. (Order from GPO, Number D101.11: 5-232/3 TM5-232). Listed as Army 11.

Department of the Army, Topographic Surveying, 1953. (Order from GPO, Number D101.11: TM5-234).

Brinker, Russell C., Elementary Surveying, (International Textbook Co., Division of Intext Educational Publishers: Scranton, Pennsylvania 18515), 1969.

Davis, Raymond E., Surveying Theory and Practice, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1966.

Kissam, Phillip, Surveying Practice, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1971.

Spier, R. F., Surveying and Mapping: A Manual of Simplified Techniques, (Holt, Rinehart and Winston, Inc.: 383 Madison Avenue, New York, New York 10017), 1970.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Area computation
- Interpretation of compass

Communication Skills

- Drawing maps from notes
- Numbering and lettering
- Manufacturer's and instructional literature
- Student Resource Manual

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Direct Angle Traverse

SUB OBJECTIVE 26: The student will demonstrate ability to perform a direct angle traverse using a transit, tape and other tools.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates a direct angle traverse.

A. Set hubs (angle points).
B. Set graduated circle plate on "O", and sight along a known azimuth line (magnetic North) to orient instrument.
C. Turn interior angles and enter in field book.
D. Enter magnetic bearing in field book.
E. Measure distances between hubs with tape and enter in field book.

II. Students perform a direct angle traverse.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Running Elevations

SUB OBJECTIVE 27: The student will demonstrate ability to run elevations using a transit or level and compute elevations from field book data.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates running elevations using a transit or level.

A. Set up instrument at convenient point.
B. Shoot back sight (+ sight) to point of known elevation.
C. Determine height of instrument (H.I.) by adding back sight reading to known elevation.
D. Take shots (- sights) at each hub using as many instrument set-ups as necessary.
E. Make entries in field book.
F. Compute elevations by subtracting (- sight) from H.I.

II. Students run and compute elevations.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Stadia

SUB OBJECTIVE 28: The student will demonstrate ability to locate points and measure distances using a transit with a stadia.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates locating points and measuring distance with a transit using stadia.

A. Set up instrument at a convenient point.
B. Determine H.I. by standing leveling rod next to instrument and measuring to ground.
C. Orient instrument to known azimuth (magnetic North).
D. Turn angles to all hubs.
E. Take hosts of surface features and elevation changes, in addition to other desired data.
F. Read middle hair elevation (- sight) on stadia rod or leveling rod.
G. Set lower hair on nearest even foot mark of stadia rod.
H. Read intercept and enter in field book.
I. Release rod man.
J. Record azimuth in field book.
K. Use as many setups as necessary to record all features.

II. Student locates points and measures distance using a transit with stadia.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Preparing Maps

SUB OBJECTIVE 29: The student will demonstrate ability to prepare map from notes contained in field book.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates mapping from information contained in field book.

   A. Check traverse for closure: (n-2) 180° making adjustments (if required).
   B. Select an appropriate scale.
   C. Choose "North" and draw in an arrow.
   D. Draw up traverse using protractor and straightedge.
   E. Spot in surface features.
   F. Spot in stations and elevations.
   G. Draw in contour lines at appropriate interval.
   H. Letter in all pertinent information (Reinhardt style).

II. Student draws map from information contained in field book.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to use transit, tape, wood stakes, string lines and other tools to perform a building site survey.

SOURCES OF INFORMATION

Department of the Army, Construction Surveying, 1964. (Order from GPO, Number D101.11: 5-233/2 TM5-233). Listed as Army III.

Department of the Army, Elements of Surveying, 1971. (Order from GPO, Number D101.11: 5-232/3 TM5-232). Listed as Army II.

Davis, Raymond E., Surveying Theory and Practice, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1966.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review of math skills required in surveying careers

Science

- Microwave devices in surveying

Communication Skills

- General review of reading, writing, drawing and interpreting skills
- Review career opportunities and educational preparation required beyond high school
- Student Resource Manual

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Site Plan Surveys

SUB OBJECTIVE 30: The student will demonstrate ability to perform a site plan survey using transit tape, field notes, iron stakes and other tools and prepare a map from field notes and sketchboard.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates performing a site plan survey and preparing a map from field notes and sketchboard.

A. Examine city plat to determine location of property corners, water mains, sewer lines, gas lines and other lines, if any.
B. Set permanent markers at corners (iron stakes or pipes).
C. Determine "North" and record on sketch.
D. Use property lines for reference to locate all poles, structures and objects on site (tape measurements only are used). Note material of construction.
E. Measure lengths of property line.
F. Locate property line from walks and measure width of walks.
G. Note names of streets and measure width.
H. Note type of pavement of streets and walks.
I. Locate electric lines, water lines, gas lines and other lines if any; state size and show exact location on sketch.
J. Note size and kind of trees and locate on sketch.
K. Shoot elevations of sewer inverts from manholes to hundredths and determine gradient of the sewer.
L. Shoot elevations to hundredths on sidewalks and curbs at intervals of 50'.
M. Shoot ground elevations to tenths at corners of 50' square.
N. Record data and information on sketchboard.
O. Prepare a map using field notes and field sketchboard.

II. Student performs a site plan survey using transit, tape, field notes, iron stakes and other tools.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Staking Out a Building

SUB OBJECTIVE 31: The student will demonstrate ability to use wood stakes and string lines to stake out a building on the job site.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates staking out a building on the job site.

   A. Locate property lines from sketch.
   B. Locate other useful information from sketches (such as electrical services, piped utilities, sewers, etc.).
   C. Tape distances to building corners from property lines using plat plan as a reference.
   D. Set stakes at corners of proposed structure.

II. Students locate a building on the job site.

TESTING AND INSPECTING

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ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to perform field testing operations for concrete.

SOURCES OF INFORMATION

ASTM Annual Standards, (American Society for Testing and Materials: 1916 Race Street, Philadelphia, Pennsylvania 19103), 1970.

Baumiester, T., ed., Standard Handbook for Mechanical Engineers, 7th ed., (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1967.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Charts, tables
- Gauge interpolation

Science

- Concrete testing
  - Slump
  - Compression
  - Batch inspection

Communication Skills

- Technical testing literature
- Student Resource Manual
- Vocabulary development

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Forms Inspection

SUB OBJECTIVE 1: The student will demonstrate ability to field test concrete form work.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates field testing concrete form work.

A. Inspect to see that joints are tight enough to prevent mortar leakage.
B. Inspect to see that braces are properly installed to resist form failure or buckling out of line.
C. Inspect to see that forms do not have serious flaws and are properly oiled for easy stripping.

II. Students perform field testing on concrete form work.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Slump Test

SUB OBJECTIVE 2: The student will demonstrate ability to perform a slump test on a concrete mix.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates performing a slump test on a concrete mix.

A. Fill the sampling cone to a height of 4" with a random sampling of concrete during the pour.
B. Rod the concrete 25 times with the standard rod which is 5/8" diameter and 24" long and bullet-shaped at the end.
C. Fill the sampling cone another 4" and repeat the rodding procedure.
D. Fill the sampling cone to the top and repeat the rodding procedure.
E. Procure a flat and level spot such as a piece of plywood and set the sampling cone down. Release the concrete and place the cone next to the concrete with the 5/8" diameter rod across the top of the sampling cone and projecting over the concrete.
F. Measure the distance from the bottom of the rod to the top of the concrete. This distance is called the slump of the concrete. Report the slump to the nearest quarter inch.

II. Students perform a slump test on a concrete mix.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Compression Testing Concrete

SUB OBJECTIVE 3: The student will demonstrate ability to perform a compression test on a concrete cylinder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates performing a compression test on a concrete cylinder.

A. Random samplings are gathered from the pour in standard test cylinders.
B. The test cylinders are placed in a wet humid room and cured for 3, 7 or 28 days, depending on the specifications.
C. Remove the cylinders from the curing room.
D. Cap the ends with either molten sulphur or lead so as to distribute the load evenly through the cylinder.
E. Place the cylinder in the testing machine and increase the loading until the cylinder fails.
F. Record the load at which the cylinder fails.
G. Include the following information in the test report:
Identification number
Diameter in inches
Cross sectional area (square inches)
Maximum load
Type of fracture
Defects in cylinder or caps
Age of specimen

II. Students perform a compression test on a concrete cylinder.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Field Inspecting Concrete

SUB OBJECTIVE 4: The student will demonstrate ability to perform visual field inspection of reinforcing steel, aggregate material and placement of concrete.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates visual field inspection of reinforcing steel, aggregate material and concrete placement.

   A. Determine that reinforcing steel is free from oil or other substances detrimental to forming a bond between concrete and steel.
   B. Determine that aggregate material is sharp cornered and relatively free from mud balls and other impurities.
   C. Ensure that concrete is not over-vibrated during placement (bath segregates under these conditions).
   D. Ensure that concrete is not placed during freezing weather.

II. Students inspect reinforcing steel, aggregate material and placement of the concrete.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to inspect and test wood.

SOURCES OF INFORMATION

ASTM Annual Standards, (American Society for Testing and Materials: 1916 Race Street, Philadelphia, Pennsylvania 19103), 1970.

Baumiester, T., ed., Standard Handbook for Mechanical Engineers, 7th ed., (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1967.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Formula computations

Science

- Stress and loads
- Expansion and contraction
- Features and limitations of wood

Communication Skills

- Student Resource Manual
- Manufacturer's and association literature

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Wood Testing

SUB OBJECTIVE 5: The student will demonstrate ability to perform tests on wooden beams in flexure.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates testing wooden beams in flexure.

A. Select a specimen with a span-depth ratio of about 15 to 1.
B. Examine specimen for defects and reinforcements and note these.
C. Place specimen across 2 rigid supports with ends of specimen supported by rocker plates.
D. Drive two nails into the beam's neutral axis over the reactions (bearing plates) and tie a wire between the nails.
E. Attach a scale to the beam at mid-span.
F. Load the beam at mid-span evenly through bearing plates by means of a testing machine, if available, or weights, such as sandbags, concrete, etc., if test is to be accomplished in the field.
G. Record the load deflection data as the beam is loaded.
H. Record the load at failure and description.
I. Include the following in the report:
1. Complete description of the beam, shape, form, defects, whether laminated or not, how fabricated, species of the wood and other physical or chemical characteristics relating to the quality of the wood.
2. History of seasoning and conditioning, if any.
3. Diagram of supports, lateral supports and type of equipment used to portray picture of the loading conditions.
4. Deflection apparatus.
5. Cross-section dimensions of specimen.
6. Compute physical and mechanical properties of specimen, including moisture content, specific gravity, flexural strength, modulus of elasticity and proportional limit.
7. Shear and bending movement valves and deflections.
8. Description of failure.

II. Students test wooden beams in flexure.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Wood Testing

SUB OBJECTIVE 6: The student will demonstrate ability to perform field tests on plywood.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates field testing plywood. Testing will include:

   A. Inspection for straightness.
   B. Inspection for excessive knotholes and other defects.
   C. A sample to destruction by mounting the sample between two stands and piling on sandbags or other weights until sample fails. Compute stress and check to see if sample meets specified loads.
   D. Plywood by inspection for defects and straightness.
   E. A plywood panel to destruction using the same method outlined above and determine whether or not sample meets specified strength requirements.

II. Students field test woods.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to test construction masonry.

SOURCES OF INFORMATION

ASTM Annual Standards, (American Society for Testing and Materials: 1916 Race Street, Philadelphia, Pennsylvania 19103), 1970.

Baumeister, T., ed., Standard Handbook for Mechanical Engineers, 7th ed., (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1967.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Formula computations
- P.S.I.

Science

- Properties of masonry and ceramic materials
- Absorption

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Brick Institute of America materials

CONTENT TITLE: Masonry Testing

SUB OBJECTIVE 7: The student will demonstrate ability to field test shipments of masonry units.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates field testing shipments of masonry units.

A. Visually inspect shipments for color, cracks, broken units or other defects which may be cause for rejection.
B. Estimate damage rate if any; evaluate the quantity and compare with bill of lading to ensure conformance.

II. Students field test shipments of masonry units.

CONTENT TITLE: Masonry Testing

SUB OBJECTIVE 8: The student will demonstrate ability to field test mortar and the placement of masonry.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates field testing mortar and masonry placement.

A. Test mortar by inspection to determine if appearance and bond are satisfactory.
B. Test by inspection that bricks are thoroughly wet before laying.
C. Test by inspection to see that masonry is laid in a full bed of mortar and that vertical joints are full.
D. Determine by inspection that half bricks are not used except to make corners or to form a design.

II. Students test mortar and the placement of masonry.

CONTENT TITLE: Masonry Testing

SUB OBJECTIVE 9: The student will demonstrate ability to perform an absorption test on masonry units.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates performing an absorption test on masonry units.

A. Weigh specimens.
B. Place in boiling water for a period of five hours.
C. Weigh specimens again.
D. Compute absorption percentage by weight. Brick specimens should not absorb over 20 percent moisture.
E. Similarly, determine that clay tile does not absorb over 16 percent by weight or that concrete tile does not absorb over 10 percent by weight.
F. Report the absorption weight in percent.

CONTENT TITLE: Masonry Testing

SUB OBJECTIVE 10: The student will demonstrate ability to perform compression tests on masonry units.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates performing compression tests on masonry units.

A. Cap ends of units with gypsum plaster to distribute load evenly.
B. Place units in testing machine and apply load gradually until unit fails.
C. Divide the load at failure by the cross-sectional area of the unit to obtain the strength of the unit in pounds per square inch.
D. Strength should be as specified or 2500 psi minimum for brick and 700 psi for clay tile.

II. Students perform compression tests on masonry units.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to perform field tests on steel work.

SOURCES OF INFORMATION

ASTM Annual Standards, (American Society for Testing and Materials: 1916 Race Street, Philadelphia, Pennsylvania 19103), 1970.

Armco Open Web Steel Joists, (Armco Steel Corp., Metal Products Division: 1939 Armco Avenue, Middletown, Ohio 45042).

Catalog 99-I, (Granco Steel Products Co.: 6506 North Broadway Street, St. Louis, Missouri 63147).

Catalog 248, (Inland-Ryerson Construction Products Co.: 4101 Burnham Street, Milwaukee, Wisconsin 53201).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review math requirements for job entry and/or higher education

Science

- Properties and characteristics of various metals
- Welding theory
- Protective coatings
- Review science requirements for job entry and/or higher education

Communication Skills

- Technical literature
- Manufacturer's literature
- Student Resource Manual
- Review communication skills required for job entry and/or higher education
- Review job and career opportunities in testing and inspecting
  - Job
  - Junior colleges and technical schools
  - 4-year college programs

CONTENT TITLE: Steel

SUB OBJECTIVE 11: The student will demonstrate ability to examine mill test reports for structural and reinforcing steel to determine if contract specifications are maintained.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates examining mill test reports for structural and reinforcing steel to determine that contract specifications are maintained.

   A. Obtain copies of mill test reports from the steel supplier.
   B. Check heat numbers to determine that the steel on the job is the same as listed on mill test reports.
   C. Refer to ASTM for specifications to be maintained.
   D. Compare chemical content of steel as noted in the mill test reports to allowable chemical content as listed in ASTM specs.
   E. Compare tensile strength test of steel as shown in the mill test reports to allowable as listed in the specs.
   F. Compare yield strength as listed on mill test reports to yield strength specified.

II. Students examine mill test reports for structural and reinforcing steel to determine if contract specifications are maintained.

CONTENT TITLE: Steel Welds

SUB OBJECTIVE 12: The student will demonstrate ability to test welds in the field.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates testing welds in the field.

A. Determine if weld is free from holes, slag and spatter by inspection and peening.
B. Determine that parent metal is free from undercuts or overcuts by inspection.
C. Determine if weld has been applied according to plan by inspection.

II. Students test welds in the field.

CONTENT TITLE: Painted Steel

SUB OJBECTIVE 13: The student will demonstrate ability to inspect paint in the field.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates testing paint in the field.

A. Inspect containers to see if paint which has been used is the paint specified.
B. Check for compatibility between primers and paint.
C. Check painted members to see if they are free from runs, drips or other defects.

II. Students inspect paint in the field.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Steel

SUB OBJECTIVE 14: The student will demonstrate ability to test steel joists in the field.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates testing steel joists in the field.

A. Test joists for straightness by inspection.
B. Test welds by inspection and peening.
C. Inspect paint for drips, runs or other defects, especially if joists are exposed.
D. Inspect erection procedures to see if joists are erected to manufacturer's specifications.
E. Test one joist to destruction (if required) by mounting between two stands and stacking sand bags, concrete or other weights on top of the joist until it fails. Compute the weight required to fail the joist and determine if the joist meets specifications.

II. Students test steel joists in the field.

CONTENT TITLE: Steel Decking

SUB OBJECTIVE 15: The student will demonstrate ability to field test steel roof decking.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates field testing steel roof decking.

A. Test appearance by inspection to guard against excessive warpage, bends or kinks due to faulty handling.
B. Test installation by inspection to make sure the deck is installed and attached per manufacturer's specifications.
C. Test one panel to destruction by mounting between two stands (per manufacturer's specifications) and loading with sand bags, concrete or other weights until panel fails. Compute weight and determine if the roof deck meets specifications.

II. Students field test steel roof decking.

MATERIAL DISTRIBUTION

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

MATERIAL DISTRIBUTION

Material distribution is a wide occupational family comprised of truck drivers, warehouse workers, sales people and many others. These people often do not look at their jobs as being directly related to the construction industry. However, material distribution is a vital link between the forests, mines and factories and the construction site. Their jobs involve the moving of products offering the American consumer a choice in the construction marketplace.

Obviously, any one program cannot combine all or even most of the employment possibilities in material distribution. Therefore, the instructional suggestions which will be made in this section of the Engineering, Support and Management guide will best fit a distributive education or industrial coop program.

The example used in the following instructional suggestion is that of a lumber yard salesperson. This example was selected because it represents a reasonable cross-section of the jobs and careers available in the material distribution area. It is a service job providing information and products to contractor and homeowner alike. This job requires the taking of complicated and technical orders, checking incoming and outgoing materials, working with the public and product knowledge.

In short, a salesperson working in a lumber yard must be skilled in at least six areas:

1. They must be as familiar as possible about the total construction industry.
2. They must know construction materials and processes.
3. They must know the construction field of business and finance.
4. They must be competent as mathematicians and estimators.
5. They must be able to read and interpret blueprints and specification sheets.
6. Lastly, they must be accomplished salespersons.

Continued...

Ma ructional materials exist which will help in training for the or onal and operations areas. Product awareness must be de d through experien on the job. Some of the general competencies which should be displayed by the student in the organizational, operations and product awareness areas are listed below.

I. ORGANIZATIONAL AWARENESS

The student will prepare a block diagram of the lumber company's organization.

The student will outline the ordering policy of the lumber company, preparing separate outlines where necessary.

The student will outline the pricing system of the lumber company, describing other typical systems and justifying each.

The student will outline the lumber company's policy with regard to complaints and problems and define the responsibility of various employees.

The student will diagram the basic paperwork routes for: (1) contract sales, credit sales, cash sales and sales of accounts; (2) returns on contract sales, credit, cash and accounts; (3) exchanges for each type of sale as above; and (4) warranty adjustments on all sales as above.

The student will check with other local companies to ascertain availability of various materials not stocked by the employing company.

II. OPERATIONS AWARENESS

The student will outline cash register operations for taxable sales, non-taxable sales, opening and close-out operations.

The student will demonstrate ability to operate a calculator; to add, subtract, multiply and divide, take squares and square roots, compute areas, maintain running totals as required in estimating building materials.

Continued...

Given a complete set of blueprints, the student will demonstrate ability to prepare estimates using the Equivalent Method, the Completed Unit Method and the Survey or Item-by-Item Count Method.

In a timed proficiency examination designed by the instructor, the student will demonstrate ability to locate manufacturers and prices of at least ten items, one from each of ten classes of building materials in a retail catalog.

III. PRODUCT AWARENESS

The student will list the major manufacturers of various building materials.

The student will identify major contributions of large building material manufacturing firms.

The student will list major characteristics and applications of the most popular building materials.

The student will determine price breaks for specific building products.

The student will outline the various points to be made in a product demonstration.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate a rudimentary product awareness by, 1) listing the major manufacturers of building materials and the major materials the various manufacturers produce, 2) determining and listing the major points of price breaks and discounts for specific products, 3) listing the major characteristics and applications of popular building materials and 4) developing a basic sales procedure for various specific materials.

SOURCES OF INFORMATION

Product catalogs, manufacturers' price lists, blueprints, etc.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Decimals
  - Fractions
- Material and tool sizing
- Scale measurements
- Square and cubic measures
- Estimating
- Percentage

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Vocabulary development
- Review of job and career opportunities

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Product Awareness

SUB OBJECTIVE 1: The student will demonstrate ability to list the major manufacturers of various building materials.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor identifies major manufacturers of various building materials. Building materials will include:

A. Wood products.
B. Masonry material and products.
C. Iron and steel products.
D. Aluminum materials and products.
E. Paints and protective coatings.
F. Bituminous products.
G. Gypsum materials and products.
H. Asbestos cement materials and products.
I. Resilient flooring materials and products.
J. Carpeting materials and products.

II. Students identify major manufacturers of various building materials.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Product Awareness

SUB OBJECTIVE 2: The student will demonstrate ability to identify major contributions of large building material manufacturing firms.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses product production of major manufacturers.

A. Identify or list top manufacturers of building materials and products.

B. Obtain catalogs from specific manufacturers detailing that manufacturer's basic production areas.

C. Drill students in identifying major production areas of manufacturers.

II. Students identify product production areas of major manufacturers.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Product Awareness

SUB OBJECTIVE 3: The student will demonstrate ability to list major characteristics and applications of the most popular building materials.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses popular building materials, their characteristics and applications.

A. Outline characteristics (such as available sizes, shapes, colors, textures, weight and bulks, durability, costs, etc.) for a variety of materials, organizing presentation by material application; i.e., outline characteristics for lumber, paneling, flooring, insulation, roofing, siding, drywall, masonry, prefab products such as doors and windows, cabinets, etc.

B. Outline standard applications of these materials; i.e., discuss typical weights of, for example, felt paper underlayments, typical grades of, for example, framing lumber, and so on. Students should become relatively familiar with these standard applications.

C. Display popular building products, where possible, with samples or by taking students on field trips to see the materials on construction sites or at lumber yards.

II. Students identify popular building materials, their characteristics and applications.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Product Awareness

SUB OBJECTIVE 4: The student will determine price breaks for specific building products.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses price breaks and pricing theory.

A. Outline areas where money is saved by buying in bulk.
B. Demonstrate locating price break information in manufacturer's pricing sheets.
C. Demonstrate, from a given quantity estimate, determining if price breaks may be offered the customer on the basis of the quantity of his order.
D. Drill students on price break data they may frequently encounter.

II. Students practice determining price breaks.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Product Awareness

SUB OBJECTIVE 5: The student will demonstrate ability to outline the various points to be made in a product demonstration related to the product itself.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses major points of interest concerning various building products.

   A. Mention that product selected must be "right" for the job; i.e., its price, characteristics and availability must match job specifications.
   B. Demonstrate selecting materials when various selection parameters are known.
   C. If several may be reasonably selected, outline important characteristics a customer may wish to consider before making a final selection.

II. Students outline points to be made in a product demonstration.

BLUEPRINT READING

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ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to sketch symbols, conventions and abbreviations.

SOURCES OF INFORMATION

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Muller, Edward J., Architectural Working Drawing, (Prentice Hall: Englewood Cliffs, New Jersey 07632).

Bureau of Naval Personnel, Blueprint Reading and Sketching, NAVPERS 10077-C, 1968. (Order from GPO, Number D208.11: B62/968.)

Walker, John R., Exploring Drafting: Basic Fundamentals, (Goodheart Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1972.

Wyatt, William E., General Architectural Drawing, (Charles A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

A REQUIRED TRAINING SEGMENT FOR EVERY STUDENT IN PHASE IV SKILL DEVELOPMENT FOR CONSTRUCTION.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Scale measurements

Communication Skills

- Blueprint symbols
- Vocabulary development

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Symbology

SUB OBJECTIVE 1: The student will demonstrate ability to sketch building material symbols and symbol details.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates sketching symbol details. Demonstrations include:

A. Constructing architectural symbols in plans and elevations. Include: Wood, concrete, brick, stone, tile, gypsum, insulation, metal, earth, floor finishes, bath tubs, showers, water closets, urinals, drinking fountains, lavatories, sinks, built-ins.

B. Sketching plumbing symbols. Include: Water heater, floor drain, hose bib, clean out, fresh air intake, sump pit, leader, service sink, laundry tray.

C. Sketching piping symbols. Include: Soil or waste, vent, cold water, hot water, acid waste, sprinkler drain, vacuum cleaner, gas.

D. Sketching ductwork symbols (heating and ventilation). Include duct size (lst fig - width; 2nd fig - depth), direction of flow, rise or drop in duct, register, supply grille, exhaust, louver opening.

E. Sketching steel shapes. Include: I beam, wide flange, channel, unequal leg angle, equal leg angle, tee.

F. Sketching electrical symbols. Include: Ceiling outlet, blanked outlet, drop cord, junction box, pull switch - ceiling, exit lights on walls, exit lights on ceilings, bracket outlet, single pole light switch, double pole light switch, three way light switch, light switch with pilot light, key operated switch, waterproof switch, generator, motor, annunciator, floor outlet, fluorescent light, lighting panel, power panel, duplex convenience outlet, convenience outlet - single, triplex, waterproof convenience outlet, range outlet, switch and convenience outlet, radio and convenience outlet, clock outlet, special purpose, push button, buzzer, bell, outside telephone, interconnecting telephone, electric door opener, fire alarm station, fire alarm bell, exhaust fan, air conditioning.

II. Students sketch symbols.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to sketch and read floor plans, foundation plans, framing details and elevations.

SOURCES OF INFORMATION

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Bureau of Naval Personnel, Blueprint Reading and Sketching, NAVPERS 10077-C, 1968. (Order from GPO, Number D208.11:B62/968).

Walker, John R., Exploring Drafting: Basic Fundamentals, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1972.

Wyatt, William E., General Architectural Drawing, (Charles A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Centerline measurements
- Degrees and angles
- Radii and arcs

Communication Skills

- Making working drawings
- Lettering

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Floor Plans

SUB OBJECTIVE 2: The student will demonstrate ability to develop and sketch a floor plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates sketching a working floor plan on a 1/4" = 1' scale.

A. Sketch in outside wall lightly--then sketch all partitions.
B. Sketch in doors and windows lightly.
C. Sketch in centerlines of doors and windows lightly.
D. Sketch in plumbing fixtures lightly.
E. Sketch in bath and kitchen cabinets, vanity, linen closets.
F. Sketch in special built in features such as bookcases, linen closets, fixtures, etc. Include special detail symbols for each.
G. Sketch in room titles and titles of drawings.

II. Students sketch a working floor plan.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Floor Plans

SUB OBJECTIVE 3: The student will demonstrate ability to dimension a working floor plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates dimensioning a floor plan.

A. Illustrate dimension lines (unbroken lines with dimensions placed above the lines).
B. Demonstrate using foot and/or inch marks.
C. Mention that dimensions of more or less than I foot are expressed in feet and inches or just inches.
D. Illustrate technique of reading dimensions from the right or bottom of the drawing.
E. Demonstrate placing overall building dimensions outside of other dimensions.
F. Demonstrate method of indicating that room sizes are shown as width and length.
G. Illustrate methods of indicating door and window sizes, (may be shown on door and window schedules or dimensioned on centerline).
H. Mention that rooms are dimensioned from wall to wall, exclusive of wall thickness.
I. Demonstrate indicating stair risers and over length, with arrow indicating up or down.
J. Complete drawing with title block and margin.

II. Students dimension a floor plan.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Foundation Plans and Framing Details

SUB OBJECTIVE 4: The student will demonstrate ability to draw a foundation plan (basement).

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a foundation plan for a basement.

A. Select fill and indicate on drawing.
B. Provide for vapor barrier.
C. Use 4" concrete floor with 6' x 6' - 10/10 wire mesh.
D. Allow for minimum clearance of 7'10" from basement floor to 2 x 10 ground floor joists.
E. Draw exterior walls (10" placed concrete foundation walls, T foundation with keyway).
F. Add 4" cap block.
G. Add termite shield.
H. Provide a 2 x 6 sill plate.
I. Use 2 x 10 joists (16" o.c., with insulation).
J. Use interior concrete beams for slab at least every 15' and always under bearing partitions.
K. Draw girders.
L. Provide for a floor drain or sump pump.
M. Indicate that outside of basement should be covered with 2 layers of 15 pound felt and hot mop.
N. Draw fireplace (foundation).
O. Draw staircase (foundation).

II. Students draw foundation plan for a basement.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Elevations

SUB OBJECTIVE 5: The student will demonstrate ability to sketch a set of detailed elevations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates sketching a detailed elevation. Sketches will include:

A. Steps.
B. Columns.
C. Windows.
D. Exterior doors.
E. Vertical, horizontal siding or brick veneer.
F. Porches.
G. Metal down spouts and gutters.
H. Rafter ends or fascia.
I. Eave lines.
J. Gable ventilators (louvers).
K. Roof dormers (cupola).
L. Roof line.
M. Chimney stack and flashing.
N. Exterior basement door and windows.
O. Roof pitch.
P. Ground line and finished grade.
Q. Ceiling line.
R. Asphalt shingles.

II. Students sketch a detailed elevation.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

OVERALL OBJECTIVE: The student will demonstrate ability to read and sketch details for two story residences, such as fireplaces, stairwells, wall sections and floor plans.

SOURCES OF INFORMATION

Federal Housing Administration, Department of Housing and Urban Development, Minimum Property Standards for One and Two Living Units. (Order from GPO, Number HH2.17/4:965).

French and Vierck, Engineering Drawing and Graphic Technology, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1972.

Muller, Edward J., Architectural Working Drawing, (Prentice-Hall: Englewood Cliffs, New Jersey 07632).

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Wyatt, William E., General Architectural Drawing, (Charles A. Bennett Co., Inc.: 809 West Detwieller Drive, Peoria, Illinois 61614), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Sketching
- Technical literature
- Vocabulary development

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Stairways

SUB OBJECTIVE 6: The student will demonstrate ability to sketch a stairway.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a stairway.

A. Rough stairwell opening, first floor; provide for double joist (2" x 8"), header (2" x 8" stairwell header), finished floor, first floor, sub-floor, finish stringer (carriage), headroom (minimum 6'8"), landing (top or bottom of stairs), platform and joist hangers.

B. Prepare rough and finish drawings for the staircase. Include bull nose, handrail, newel, nosing, riser (7-1/2" normal), run, tread (10" normal), unit rise, unit run, winder, baluster, total run, finished floor, ground floor and sub-floor.

C. Discuss the different types of stairs or stairways used such as single flight (straight run), two flights with landing between flights, "L" shape or 90° turn with one or more intermediate landings between floors, "U" shape of 180° turn with full width landing at turn in "U", circular stairways and eliptical stairways.

D. Discuss dimensions of standard stairways.

1. Minimum width of stairs should be not less than 3' (4' is preferred).
2. 6'8" headroom height from stair tread to ceiling should be allowed.

E. Dimension stairwell opening.

F. Dimension total staircase run.

G. Construct distance from bottom of top tread (or first floor) to top of nosing (first, sub-floor and finished floor).

II. Students draw a stairway.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Fireplaces

SUB OBJECTIVE 7: The student will demonstrate ability to sketch a fireplace detail.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates sketching a fireplace detail. Sketches will include drawings of:

   A. Foundation; include basement floor or ground floor with footing, ash pit, ash pit door (clean-out door), vent brick, ash dump, hearth and list, materials, reinforcing and construction.
   B. Fireplace; include welded steel prefabricated fire box or fire brick lining (self made fire box), angle iron brace for lintel bar (usually 4" x 1/4" angle iron), damper, face (rock or brick), smoke shelf, air space around wood framing (usually 2") and mantel detail.
   C. Chimney; include smoke chamber and throat, flue lining, flue support, steel anchor straps, chimney cap, (chimney should be at least 2' above ridge board) and flashing.

II. Students sketch a fireplace detail.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Wall Sections

SUB OBJECTIVE 8: Student will demonstrate ability to sketch a two story typical wall section.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor will demonstrate sketching a two story typical wall section. Sketches will include drawings of:

A. Foundation section. (Construction details may be the same as for basement foundation plan with the exception that all slab details are omitted.)

B. Ground level wall section. The following details are suggested: 2 x 4 plates, flashing, 1/2 x 8 anchor bolts 4' o.c., base and shoe, wall ties, every 4th course with corrugated galvanized wall ties, 2 x 4 studs 16" o.c. with insulation, 3/4 sheathing material or treated celotex sheets, 15 pound felt, 1 air space, brick or cut stone with soldier course at top, two 2 x 3 plates, 1/2 sheet rock (gypsum board) or wood paneling with ceiling tile, 2 x 8 joist @ 16" o.c. with insulation, with 2' x 8" cut-in, 3/8 soffit-w/molding, ship lap or 1/2 plywood sub-floor, oak finish floor, base and shoe, 2 x 4 plate, 2 x 4 studs 16" o.c. with insulation, 15 pound felt on studs, 105 siding, vertical or horizontal siding, two 2 x 4 doubie plates, 2 x 6 ceiling joists, 16" o.c. with insulation, 1 x 4 let in brace (corner brace).

C. Roof. The following details are suggested: 2 x 6 ceiling joists, 16" o.c with insulation, 2 x 6 rafters, 16" o.c., decking, ship lap or 1/2 plywood, 15 pound felt, metal gravel guard or flashing, built-up tar and gravel roof or asphalt shingles, fascia, soffit with 2" continuous air vent and screen, blocking, roof pitch and roof framing.

II. Students sketch a typical two story wall section.

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

CONTENT TITLE: Floor Plans

SUB OBJECTIVE 9: The student will demonstrate ability to develop and draw the floor plan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a two story combination masonry veneer and frame residence with basement.

   A. Sketch the basement. It might include family room (or den and recreation room), fireplace, staircase and landing, storage, heating and air conditioning, an all access 1/2 bath, if grade permits, and a laundry room with floor drain.
   B. Sketch first floor. It might include an entrance hall (stair hall), living room, dining room (may be in combination with living room), kitchen, two-car garage or carport with storage and entrance into house, utility room, all access half bath, fireplace and entrance porch, necessary halls, closets, etc.
   C. Sketch second floor. It might include appropriate stair landing to provide easy and private access to all bedrooms and to one all access bathroom, master bedroom with private bath and adequate closet space, two additional bedrooms with adequate closet and easy access to the bath and stairs by way of hall, one all access bath and a sun deck with recreation facilities.

II. Students draw a two story combination masonry veneer and frame residence with a basement.

APPENDIX

ENGINEERING, SUPPORT & MANAGEMENT SERVICES

LESSON PLAN SAMPLE

OVERALL OBJECTIVE:	The student will demonstrate ability to lay out and arrange a typical printing sheet.
SUB OBJECTIVE:	To letter drawings.
TOOLS AND MATERIALS:	Lettering plate, drawing paper, drafting board.
I. Preparation	Read Wyatt, p. 45, 48
II. Presentation	Demonstrate construction of different letters using both vertical and slanting construction. Demonstrate use of letter plate.
III. Application	Students construct title block.
IV. Performance Tests	

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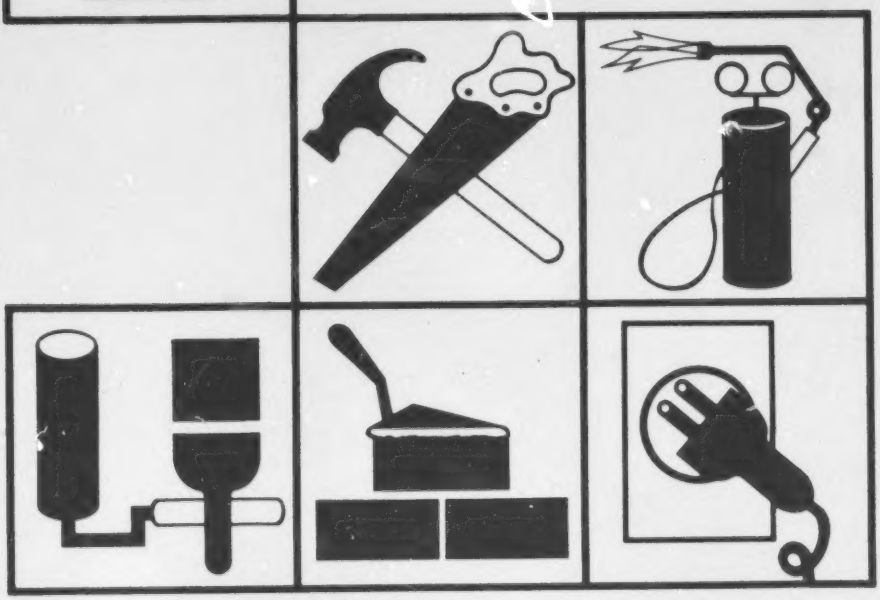

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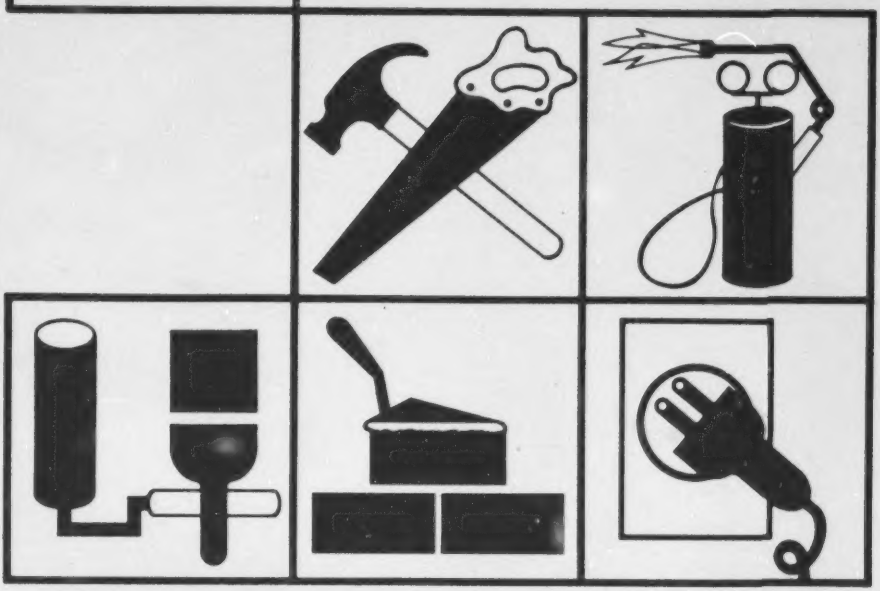

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This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

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In addition, there is an Articulation Guide designed for these instructional materials in construction.

Articulation Guide - Construction Industry Series

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ENGINEERING, SUPPORT AND MANAGEMENT SERVICES

INTRODUCTION

This manual will assist in describing construction engineering, support and management services work. For many, skills acquired in one or more engineering, support and management services training programs will lead to a job in the construction industry after high school graduation. Others may decide to go to junior or senior college for further training. In any event, a basic decision has been made for a career in the construction industry.

It should be emphasized that training in engineering, support and management services will be broad enough to permit a number of job possibilities. The skills and knowledge learned can be applied to other areas within the construction industry and even other industries. For this reason, a person should not feel "locked into" any engineering, support and management services course. Whatever jobs eventually may be held in construction, in the trades, technical, professional, management or distribution areas, experiences and preparation in engineering, support and management services classes will help.

While you are still in school, look around to see what is offered and how it can advance your future career in construction. Math classes will offer training in computations, whole numbers, fractions and decimals. Measurement is a must! Ability to measure with accuracy is a skill demanded by a technical society.

English or communication skill classes will strengthen your abilities to write, talk, draw, read and listen. These, too, are valuable tools for you to secure the kind of job you want.

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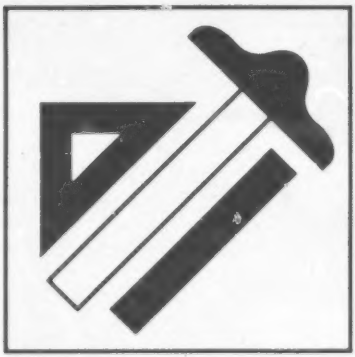
Science classes will increase your understanding of the world around us. This understanding is important to anyone in construction. Whether it be electro-magnetic force, certain insulation qualities of materials, hydraulics or ecology, science classes will help deepen an awareness and understanding of the work performed and materials used.

Social science courses will assist in a broad understanding of our political, social and economic systems. To appreciate the past will increase an awareness of the changes which affect our lives today.

Other areas which can help you are student clubs and associations; VICA, DECA, FFA, FHA, OEA and FBLA. These clubs help many to develop leadership skills and pride of workmanship.

All of the areas described are probably available at your high school. There are many others that can help those who have made a basic career decision. It is hoped that you are one of those students who have chosen your future career area.

Good luck to you in construction.



ENGINEERING, SUPPORT AND MANAGEMENT SERVICES — DRAFTING

INTRODUCTION

To make a space capsule or an electric iron, a nuclear submarine or a television set, a bridge or a typewriter, detailed drawings are needed that give the exact physical dimensions and specifications of the object and each of its parts. The workers who draw these plans are draftsmen.

Draftsmen translate the ideas, rough sketches, specifications and calculations of engineers, architects and designers into working plans which are used in making a product. Draftsmen calculate the strength, reliability and cost of materials. In their drawings and specifications, they describe exactly what materials workers are to use on a particular job. To prepare their drawings, draftsmen use instruments such as compasses, dividers, protractors, templates and triangles, as well as machines that combine the functions of several devices. They also may use engineering handbooks, tables and slide rules to assist in solving technical problems.

Draftsmen are often classified to the type of work done or level of responsibility. *Senior draftsmen* use the preliminary information provided by engineers and architects to prepare design *layouts* (drawings made to scale of the object to be built). *Detailers* make drawings of each part shown on the layout, giving dimensions, material and other information necessary to make the detailed drawing clean and complete. *Checkers* carefully examine drawings for errors in computing or in recording dimensions and specifications. Under the supervision of draftsmen, *tracers* make minor corrections and prepare drawings for reproduction by tracing them on transparent cloth, paper or plastic film. People having only high school drafting training may start out as tracers.

Draftsmen can specialize in a particular field of work, such as mechanical, electrical, electronic, aeronautical, structural or architectural drafting. Qualifications for success as a draftsman include the abilities to visualize objects in three dimensions, to do freehand drawing and apply some mathematical knowledge. Although artistic ability is not generally required, it can be helpful in some specialized fields. Good eyesight, eye-hand coordination and manual dexterity are also required for good drafting work.

DRAFTING INSTRUMENTS AND TECHNIQUES

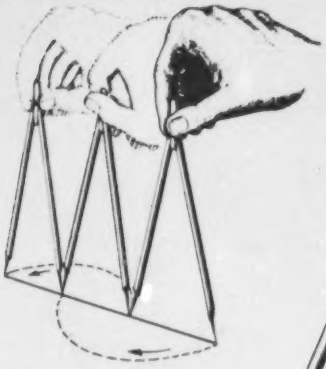
Draftsmen do most of their work with a few instruments. Drawings are done on a drawing board with a straightedge, T-square, a set of triangles, scales, pencils, an eraser, a protractor,

//

a set of curves for making irregular curved lines, rapidograph pens, ink and a set of drafting instruments. Other instruments include ruling pens, compasses and dividers. Let's look further at these instruments.

Dividers

First there are *dividers*. Dividers are similar to compasses except that both legs are provided with needle points. They are used for transferring measurements and for dividing lines into a number of equal parts. To lay off distances on a drawing, set the dividers to the correct distance, then transfer the measurements to the drawing by pricking the drawing surface very lightly with the points of the dividers. To measure off a series of equal distances on a line, set the dividers to the given distance. Then step off this distance as many times as desired by swinging the dividers from one leg to the other along the line. Dividing a given line into equal parts is slightly more complex. To divide a line into three equal



DIVIDERS

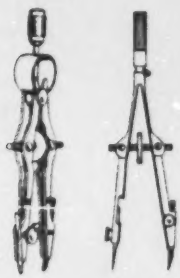
parts, first set the dividers to a distance approximately one-third the length of the line. Then step off this spread three times. If the three stepped-off distances do not equal the length of the line, increase or decrease the setting of the dividers by one-third the error. Continue this trial-and-error method until the three steps equal the line.

Proportional dividers are convenient for transferring measurements from one scale to another. They can also be used to divide lines or circles into equal parts or to get some special ratio such as feet to meters. They consist of two legs of equal length, pointed at each end and held together by a movable pivot. By varying the

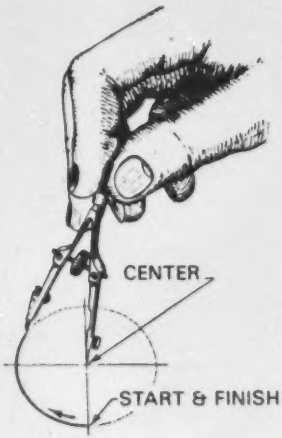
position of the pivot, the lengths of the legs on opposite sides of the pivot may be adjusted so that the ratio between them is equal to the ratio between two scales. Therefore, a distance spanned by the points of one set of legs has the same relation to the distance spanned by the points of the other set—as one scale has to the other. A thumb nut moves the pivot in a rack-and-pinion arrangement. When the desired setting is reached, a thumb-nut clamp on the opposite side of the instrument locks the pivot in place. A scale and vernier is provided on one leg to facilitate accurate setting. The dividers may be set by reference to the table of settings which is furnished with each pair; they will accommodate varying ranges of scales from 1 to 11.5. The points of the dividers are of hardened steel, and if they are handled carefully these points will retain their sharpness during long use. If they are damaged, they may be sharpened and adjusted without affecting the accuracy of the instrument, but the table of settings will no longer be exact.

Compass

The *compass* is used for drawing circles or circular arcs. The large compass usually found in a set of drawing instruments is about 6 inches long. The legs are hinged at the top so that they can be set in any desired position. The leg that has the pencil or pen



COMPASS



attached usually has a hinged joint in the middle of the leg. The other leg containing the needle point sometimes has a similar hinged joint. The pencil and pen are interchangeable so that the same compass can be used for either pencil or ink drawings. When the compass is prepared for use, the needle point should be

adjusted so that it projects about one sixty-fourth of an inch beyond the pencil lead or ink point. A compass can be obtained with a shoulder on the needle point which prevents the point from sinking too deeply into the drawing surface. The 6 inch compass is satisfactory for drawing circles to about 12 inches in diameter. On small circles (circles less than 12 inches in diameter) bow compasses are used.

Bow pens and pencils are used for drawing circles smaller than one inch in diameter. Bow dividers are used principally for transferring small measurements on a drawing. The bow instruments have a set-screw acting against a spring for adjusting the spread of the legs. The instruments are used in the same manner as compasses and dividers. The screw threads on bow instruments are delicate. Care should be taken never to force them. When you increase the spread of the legs, hold them together lightly to release the tension on the set-screw and to decrease the wear on the threads. Take care to keep the threads free from rust or dirt.

Pens

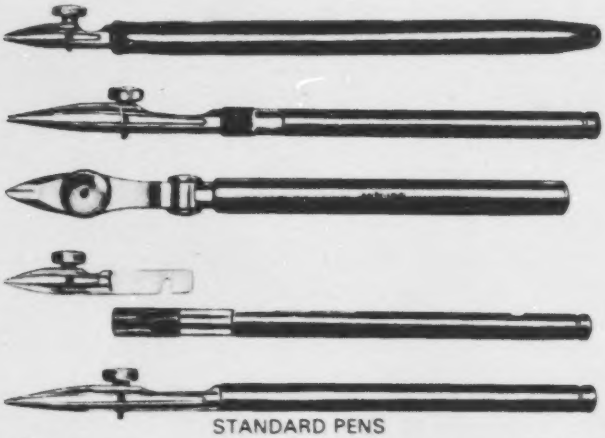
There are a variety of pens used in drafting. It requires far more experience to do a professional job in ink than it does to do one in pencil. An apprentice draftsman starts with a pencil. After learning to draw with a pencil, using the T-square, triangles, curves and compass, pens are used.

The almost universally applied inking pen is the *rapidograph*. This pen is comprised of an ink reservoir and a special ink delivery system which is designed to compensate for the drying characteristics of the India inks used. The point is a hollow tube, inside of which is a thin wire with a weight attached to it. Shaking the pen causes the wire to slide up and down inside the tube, thus breaking up the dried ink and allowing it to flow. Pens come in a variety of line sizes (from 000 to 5 or 6) and from a variety of manufacturers. These pens will require occasional cleaning. Most houses have ultrasonic cleaners for this purpose.

Some practice is required to use pens well. They must be held vertically to the paper and lines should be drawn with as smooth a motion as possible. When clogged, ink flow is started by alternately shaking and tapping gently on the paper until a smooth line is started. The pens work best on film and vellum; poorly on rough papers. Practice is required to become proficient with each type of paper.

Ruling pens are almost obsolete, but are used in special applications. Essentially, the ruling pen is used for ruling lines of uniform width with the T-square, triangles or other guides. It

should not be used for freehand work. It consists of two steel blades, called nibs, attached to a handle. The blades are of equal length, narrowed at their tips. A set-screw is used for adjusting the distance between the nibs at the tip to correspond to the width of line desired. Tightening the screw brings the nibs closer together so that the pen makes a thinner line.



STANDARD PENS

The standard ruling pen has an adjustable spring blade, limber enough to permit opening it wide to clean the inside of the nibs. Another type has a hinged blade, which allows the pen to be opened, cleaned and snapped back in place with the nibs the same width apart. This is convenient if you have to do a long piece of work which requires many lines of the same width.

Pencils

In using pencils for drafting, try to select a pencil which will make a good line on the particular surface being used. With such a pencil it should not be necessary to use so much pressure that a dent is made in the paper. On most fine tracing paper H to 3H pencils are best.

In drawing with a pencil, the width of the line made depends on the sharpness of the lead, not on the pressure. If the tip of the lead is very sharp, a thin, black line or thin, gray line can be drawn, depending on the pressure of the pencil on the paper. If the tip is slightly duller, a medium black line or medium gray line can be drawn. Wide lines are drawn with pencils with blunt tips.

Drafting room pencil sharpeners cut the wood away from the lead without cutting it and leave about 3/8 inch of the lead exposed. If no such sharpener is available, a knife or a razor blade is used to

cut the wood away from the pencil lead. A pencil should always be sharpened at the unlettered end, never at the lettered end. The reason is to preserve the symbol which indicates the grade of the pencil.

Many draftsmen prefer lead holders, which are mechanical clutch-type pencils in which may be inserted any grade of lead. In either case, round, sharp points are put on the lead with a lead pointer.

The lead exposed in either a wooden pencil or a lead holder must be dressed, or pointed, before it can be used. However, many draftsmen claim that if you draw a long line with the narrow part of the chisel point the lead does not wear down as rapidly and the line is more even. Others maintain that pencil leads, as manufactured, are harder on the outside and that the elliptical point takes advantage of the hardest part of the lead. These draftsmen use the elliptical point, which is normally used in the bow pencil, in doing other drawings.

In using a lead with either a chisel or an elliptical point, you must keep the pencil from shifting in your hand as you draw. If the pencil shifts so that the wide part of the point slants across the line, the line will vary in width. Since this is not easy to prevent, it is better for the beginner to work with a conical tip.

When making mechanical drawings in pencil, hold the pencil in an almost vertical position, just as you would hold a pen. Press the lead against the guiding edge only enough to hold the lead in contact with it. When you are using a lead with a conical tip and must draw a long line, revolve the pencil slightly as you draw and the lead will wear evenly, producing a more even line.

Keep a pad of sandpaper by your drawing table. These come with the sheets of sandpaper lightly glued together at the edges and attached to a small wooden paddle. Some draftsmen tack their sandpaper pad to some steady surface within reach, so that they need not use their hands to steady it. This eliminates the chance of their getting loose graphite dust on their fingers. If you want a clean drawing, keep your hands clean. To sharpen a lead to a conical point, rotate the pencil as you rub the tip on the pad. This keeps the abrasive action of the pad even on all sides of the lead.

There are presently on the market various mechanical pencil pointers which create a conical point. These are rotating devices, some of which clamp to the table, which contain either metal file blades or sandpaper to cut the lead.
Before you start to draw with a newly sharpened lead, test it on a small piece of scratch paper. Use a piece exactly like the paper on which you are drawing.

Drafting Tables

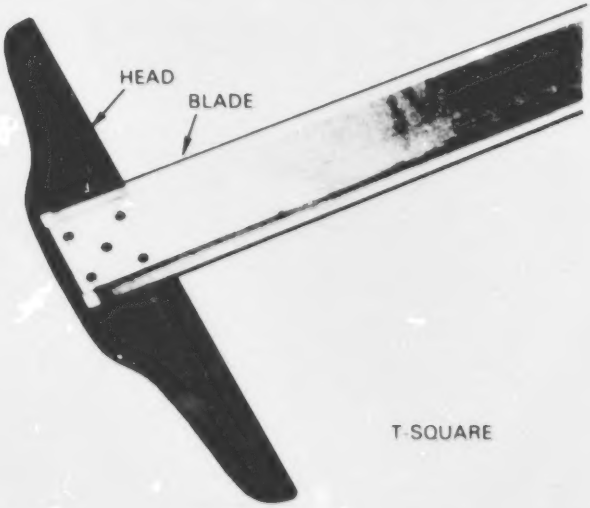
Drafting rooms are generally equipped with *drafting tables*. The top of the table is, in effect, a drawing board. The board can be adjusted to various angles to suit the man or woman using the table.

Drafting tables are available in various sizes, styles and arrangements of drawers. One type is the *light table* or tracing table. A light table has a glass working surface with a fluorescent light underneath the glass. This arrangement facilitates the tracing of prints, soiled tracings or other relatively opaque drawings.

More light is required for drafting than for normal administrative office work. If overhead lighting is insufficient, lamps should be obtained. The most popular drafting lamp is the floating-arm type of fluorescent fixture which clamps onto the desk or drafting table.

T-Square

The *T-square* gets its name from its shape. It consists of a long, straight strip, called the blade, which is mounted at right angles on a short strip called the head. The head is mounted under the



T-SQUARE

blade so that it will fit against the edge of the drawing board while the blade rests on the surface. T-squares vary from 15 inches to 72 inches in length, with the 36 inch length the most common.

The T-square is used for drawing horizontal lines, and it serves as a base for the triangle when vertical and inclined lines are drawn. Lines are drawn along the upper edge of the blade. The T-square is moved up or down to position by sliding the head along the edge of the drawing board with the left hand.

Handle the T-square carefully. If dropped, it may become useless. The T-square blade should not be used as a guide for the knife in cutting paper. Before beginning a new job, you should test the top edge of your T-square for warpage or nicks. Draw a sharp line along the top of the blade. Turn the T-square around and redraw the line with the same edge. If the blade is warped, the lines will not coincide. If the blade swings when the head is held firmly against the edge of the drawing board, the blade may be loose where joined to the head, or the edge of the T-square header or drawing board may be warped. You can usually tighten a loose blade by adjusting the screws which connect it to the head. If it is out of square or in bad condition, a new T-square should be selected.

To keep a T-square true, hang it up or lay it on a flat surface when not using it. Hang the T-square by the hole in the end of the blade, not by the head.

Parallel Straightedge

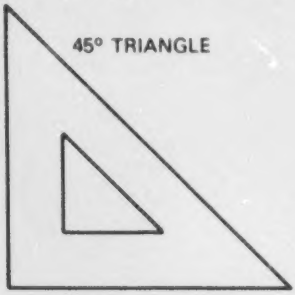
For large drawings, many draftsmen prefer a *parallel straightedge* to a T-square. It is permanently attached to the drawing board by a system of cords and pulleys to give exact parallel motion to the straightedge as it is moved over the board. The parallel straightedge has two fundamental advantages over the T-square: Supported at both ends, it maintains parallel motion automatically; and it may be moved up or down the board with pressure at any point along its length. These advantages become particularly significant when working on large drawings as a T-square tends to become unwieldy and inaccurate when working near the blade end.

Steel straightedges are used for drawing long straight lines. Sometimes a long T-square blade is used as a straightedge, but the steel straightedge is superior as its heavier weight helps to keep it in position. Putting tape at both ends of the straightedge greatly reduces unwanted movement. Using the beveled edge for inking reduces the chance of ink running under the straightedge.

Right-Angle Triangles

Right-angle triangles are used in combination with the T-square or straightedge to draw vertical and inclined lines. Plastic triangles are preferable to wooden ones because they are transparent and

work can be seen underneath. The most common triangles are the 45° and the 30°-60°. You will note that both have one 90° angle, or right angle, and that one has two 45° angles; the other



has one 60° and one 30° angle. Another triangle sometimes used is the 22-1/2° – 67-1/2° triangle.

Vertical lines are drawn by using the T-square as a base for one of the triangles. With the T-square in position, one edge of the triangle is placed against the blade and the vertical line is drawn along the vertical edge (left-handed draftsmen reverse the triangle). The same method can be used to draw lines at an angle of 30, 45 and 60° to the horizontal T-square. When you reverse the triangle, you can draw the same angle in the opposite direction. These angles may be referred to the vertical as well as to the horizontal, because the difference between the horizontal and vertical is 90°. You merely subtract the degrees of a horizontal angle from 90° to find the degrees of the vertical angle corresponding to it. For example, an angle 30° from the horizontal will automatically be 60° from the vertical.

Now suppose you want to draw a line that forms an angle of 75° with the horizontal or 15° with the vertical. This can be done by using both the 45° triangle and the 30-60° triangle with the T-square. Rest the side of the 30-60° triangle against the T-square and set the 45° triangle above it. The 30° angle and the 45° angle add up to 75°. You can get the opposite result, or 15° to the horizontal, by readjusting the triangles.

Parallel vertical or inclined lines are drawn by sliding the triangle along the blade of the T-square. You can draw a line parallel to any given line by placing the side of the triangle flush with the line and fitting the T-square or straightedge along the base. Then slide the triangle to any desired point and draw a line.

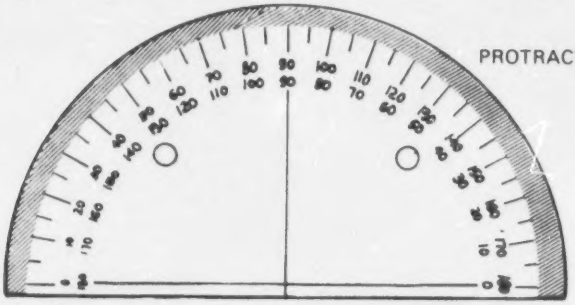
A line perpendicular to another line can be drawn by using the adjacent sides of the 90° angle. If one side is parallel with a line,

the adjacent side will be perpendicular to it. Place the long side of the triangle against the straightedge. Draw a line along one side. Then slide the triangle along the straightedge until the adjacent side is perpendicular to the drawn line.

Like other drafting equipment, triangles must be kept in good condition. To prevent warping, they should always be laid flat or hung when they are not in use. Since there is seldom enough drawer space available to permit laying triangles flat, it is best to develop a habit of hanging triangles up. If plastic triangles are dropped, their tips may be damaged. Also, triangles may warp so that they do not lie flat on the drawing surface, or the edge may deviate from true straightness. If the tips are bent, use a sharp knife to cut off the damaged part. If the triangle warps out of flat, you may be able to bend it back by hand. If this does not straighten it, leave the triangle lying on a flat surface with weights on it, or hold the triangle to the opposite curvature with weights. If the triangle warps so that the drawing edges are curved or the angles are no longer true, throw it away and get another.

Protractors

Protractors are used for measuring and laying off angles. They may be circular or semicircular. Protractors commonly used in drafting rooms are graduated in degrees and divided to 1/2°. With care, angles can be protracted to about 1/4°. The numbering



arrangement varies. Semicircular protractors are generally labeled from 0 to 180° in both directions. Circular protractors may be labeled from 0 to 360° both clockwise and counterclockwise or they may be labeled from 0 to 90° in four quadrants.

Special Guides

When you must draw smooth curved lines which are not arcs of circles, a compass cannot be used. For drawing these lines special guides—*French curves, splines* and *ship curves*—are available.

FRENCH CURVE

Other guides, such as radius curves, may be used instead of a compass when drawing arcs of circles.

French curves come in a variety of shapes and sizes and are made of transparent plastic. They are used to draw noncircular curves, such as ellipses, spirals and parabolas. These curves are usually plotted carefully on a drawing and then the lines are drawn through the plotted points.

When drawing a curve through plotted points:

- Sketch a light freehand line smoothly through the points.
- Select a section of a French curve that matches at least three points. Always make sure that the curvature indicated by the plotted points and the curvature of the French curve increase in the same direction.
- Draw the curve between the first points, but not to the last point. If you stop short of the last point that matches the French curve, your lines will blend smoothly.
- Move the French curve to the next position and extend the drawing of the curve, again stopping short of the last point.
- Continue using this method until you have completed the line.

Splines are used to make long, smooth irregular curves. They are made of flexible strips of plastic, metal or rubber that can be bent to fit almost any long curve or bend. Metal weights, called *ducks*, are used to hold this spline in place while the line is being drawn.

Flexible curve rules are made of rubber and metal and have a clear plastic ruling edge. They can be bent to a radius of 3 inches and may be adjusted to fit more than three plotted points of a curve.

Ship curves are used primarily for drawing curves peculiar to ship construction. They are made of plastic or wood and come in sets. One curve is usually sufficient to draw the entire curved line, but sometimes several of them must be fitted together to complete the curve.

Another set of irregular curves is called *mechanical engineer's curves*. These curves are similar to some of the French curves and some of the ship curves.

Radius curves may be used instead of compasses to draw arcs of circles. A radius curve is a flat, narrow sheet of plastic curved to conform to the arc of a specific circle. Stamped on each curve is the size of the radius of the circle to which its arc corresponds. Occasionally, some other method of indicating the degree of curvature is used. These curves are called railroad curves, highway curves or simply radius curves, all depending on the intended use which is reflected in the method of identifying the curvature. These curves are available in dozens of sizes ranging from 1-1/2 inch radius to 1000 inch radius. Some radius curves are curved throughout; others have a length of tangent.

Arcs of long-radius circles may also be drawn with the aid of various adjustable-radius curve devices currently on the market. These instruments are made of metal and plastic and have clear plastic ruling edges. Some of these devices have coil springs to achieve the proper tension; others make use of the flexibility of the plastic to permit adjustment to the indicated radius.

Other types of regular curves include tear drop radius curves, conic section curves, and logarithmic spiral curves.

Templates

A great deal of time is saved on jobs on which the same shape or symbol is to appear a number of times by using *templates*. Most of the templates on the market are made of transparent plastic and offer a wide variety of shapes, including ellipses, hyperbolas, circles, hexagons and arcs. There are special templates for symbols and shapes used in architectural, civil, electrical, mechanical and industrial process.

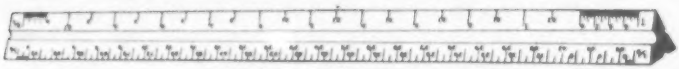
There are templates for various symbols; for example, electrical and electronic symbols, dimensioning and tolerance symbols, fluid connections symbols and so on. If the shape needed is not available, your own template may be made from cardboard, plastic, lead or sheet metal.

Measuring Scales

Once the ratio between the size of the object being drawn and the size of the object as depicted on the drawing has been determined, you will use drafting *measuring scales* to measure distances on the drawing. Since almost every line on the drawing must be of measured length, measuring scales are in constant use in the drafting room.

Scales vary in graduation, style of division, shape and materials of construction. The most inexpensive scale is made of yellow hardwood, a scale generally used by students in mechanical

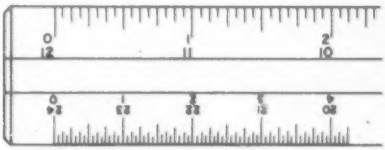
drawing classes. The scales usually used in drafting rooms are made of plastic or high grade boxwood. The plastic scales, while less expensive than boxwood scales, have clear, accurate graduations. The boxwood scales have white plastic scale faces which are permanently cemented to the boxwood. The boxwood scales are engine divided—that is, the graduation lines are cut by a highly accurate machine.



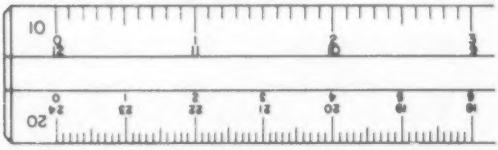
TRIANGULAR SCALE

The triangular scale provides six scale faces on one rule. The two-bevel scale provides a wide base; the scale faces are always visible. The opposite-bevel scale is easily lifted from the drawing board by tilting it. The four-bevel scale provides four scales on one small rule. This shape is usually used for pocket rules which are 6 inches long. The other shapes of scales are used for rules 12 inches long, the size generally used in drafting rooms.

As to style of division, scales may be open divided such as the 3/16 and 3/32 scales on the architect's scale. Open divided means that only the main divisions are marked throughout the length of the rule rule; the extra unit on the end is fully subdivided. Scales may also be fully divided, such as an engineer's scale. All of the units are fully subdivided throughout the length of the scale.



MECHANICAL DRAFTSMEN'S SCALE



ENGINEERS' SCALE

ARCHITECTS' SCALE

Scales may be double numbered as in the mechanical engineers' scales. This arrangement makes it convenient to measure from right to left as well as from left to right.

The types of scale graduations most often used in drafting rooms are the architects' scale, the mechanical engineers' scale and the civil engineers' scale. The mechanical engineers' scale is often called the mechanical draftsmen's scale or simply the engineers' scale. But these three scales, while the most common, are by no means the only types of scale graduations available. Metric scales are divided into centimeters (about 3/8 inch) reading to millimeters on one scale face and centimeters reading to halfmillimeters on the other face.

Drafting Machines

The *drafting machine* combines the functions of a parallel ruler, protractor and scale. Any drafting operation requiring straight parallel lines may be performed advantageously with a drafting machine.

The majority of drafting machines are constructed so that a protractor head may be moved over the surface of a drafting table. This can be done without change in orientation by means of a parallel motion linkage consisting of two sets of double bars. On the better quality machines of this type, the bearings have a means of taking up wear.

The type of drafting machine, in which the linkage is provided by two steel bands working against one another, is superior to that with pin-joint linkage, because there is less lost motion. The machine generally has steel bands enclosed in tubes. If these bands become loose through wear or expansion, the tension may be increased, although this is seldom necessary.

The protractor head is a complete circle, graduated in degrees, to which a straightedge or scale may be clamped at any desired angle. Two scales may be attached to the head at right angles to each other. The method of attaching these scales has been fairly well standardized so that a wide variety of scales can be attached or removed. Correct alignment of the scales with the board is usually accomplished by some adjustment in the control head or linkage of the machine. Any major repairs or adjustments on a drafting machine should be done by an instrument repairman and not attempted in the drafting room.

Lettering And Sketching

All drafting operations require draftsmen to do lettering and sketching. More complex drafting operations use these skills

constantly. Lettering on drawings should be uniform and in exact proportion to one another. In order to letter neatly and uniformly draftsmen must study and practice the shapes of letters. In any lettering job the draftsman should use a T-square and a triangle to draw vertical guide lines. This is done with a very hard pencil. These lines should be drawn so lightly that they do not need to be erased. Horizontal guide lines are drawn to keep the letters to a uniform height. The letters are made by a series of pen or pencil strokes. There are two sorts of strokes used—curved strokes and straight strokes. An 'S' is composed of curved strokes; a 'T' is made up of straight strokes. There are standard ways to make letters. Letters are sometimes slanted. With slanted letters, the vertical guideline is placed at 67-1/2° instead of at 90° to the horizontal. However, the strokes used in making slanted letters are similar to those used in making upright letters.

LETTERS SAME
DISTANCE APART
SPACES IN BETWEEN
BALANCED POORLY

LETTERS NOT SAME
DISTANCE APART
SPACES IN BETWEEN
BALANCED PROPERLY

LETTER SPACING

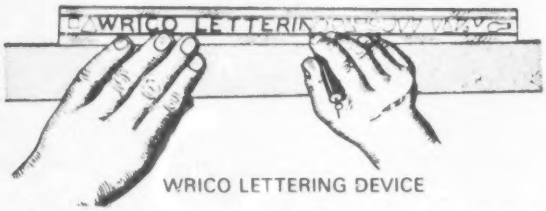
Once a draftsman has a grasp of how the different letters are made, spacing and arranging them on the page is learned and practiced. Letter spacing is important as badly spaced letters may result in poor writing even though the individual letters of the words may be well-made. The draftsman then has to balance the letters; that is, place the letters so that some of them are positioned more closely together than others.

There are no definite rules for spacing letters in words; a draftsman must simply use a great deal of trial and error practice. Besides spacing letters within words, draftsmen must also arrange proper spaces between words. Some experts say that draftsmen have six rules to follow in making letters. These rules are:

- Use guidelines to make letters uniform.
- Memorize and practice the standard letters, (these letters are called commercial Gothic).
- Letters and numerals should be stable, (the top part of the letter should be smaller than the bottom part).
- Letters should be made wider than they would be ordinarily.
- Lettering should be black, (it should be done with black ink or a soft pencil).
- Space evenly.

Today there are several mechanical lettering devices on the market which draftsmen can use to create even, well-made letters quickly and easily. These devices use templates in which the shapes of the letters and numbers have been cut. The letters are traced onto the drafting paper with special pens. The stencils slide along a straightedge. The pen is then slipped into the letter holes and it traces the letter.

LE ROY LETTERING DEVICE



WRICO LETTERING DEVICE

Transfer lettering is another way to letter drawings. The transfer lettering sheet has an alphabet printed on it. The sheet to be lettered is laid across the type sheet carefully so that the guidelines on the sheet to be lettered are lined up with the guidelines on the transfer sheet. The draftsman then takes a soft pencil or ballpoint pen and rubs the letter lightly. This is repeated for each letter in the title. The sheet is lifted away from each letter in turn and placed over the next letter. Other lettering sheets are sold which may be cut out and pasted onto the drawing.

Besides letter spacing and word spacing, the titles and lettering on a drawing should be balanced and centered. In most large drafting shops titles are not hand lettered; printed title blocks are attached to the drawing. In each block certain information is placed.

- Names of people preparing and checking the drawing.
- The title of the drawing.
- Name of design group.
- Design group approval.
- Approval by other group.
- Code number.

- Size of drawing.
- Number of drawing.
- Scale.
- Weight.
- Sheet number and the number of sheets in the drawing.

Use Of Lines In Drawings

The major job of the draftsman is to draw objects. Drawings are made up of lines. There are different sorts of lines used for each type of drawing and its parts. This is sometimes called the *alphabet of lines*. The alphabet gives standardized meanings to different lines.

Three different widths of lines are used on drawings. Thick lines are used on visible outlines, cutting plane and short break lines. Medium lines are used to indicate hidden outlines. Thin lines indicate section, center, extension, dimension, long-break, adjacent part, alternate position and repeat lines. Thin lines are about 1/1000 inch thick. Medium lines are about 1/60 inch thick. Heavy lines are between 1/30 and 1/40 inch thick. A draftsman should practice making different widths of lines until proficient. It is extremely easy to make mistakes when doing inked lines. Pencil lines should be made as uniformly as possible.

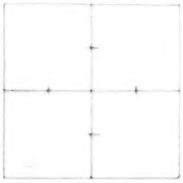
Erasure Methods

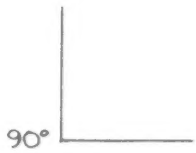
One last procedure which draftsmen need to know is erasure techniques. Light lines may be erased by rubbing a soft pencil eraser very lightly across them. Heavy pencil lines and ink lines may be removed by rubbing a Ruby pencil eraser along the line.

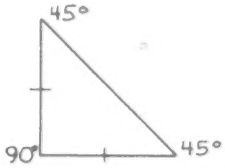
PREPARING FREEHAND AND COMPLEX DRAWINGS

Once the draftsman knows the steps to be taken in making a straight line, he or she is ready to begin making freehand drawings. There are several simple beginning sketches which can be made. Once techniques of sketching squares and rectangles, circles, ellipses and arcs are learned, this provides a basis for doing more complex sketches and drawings.

First, let's take a look at how a rectangle would be sketched. Horizontal and vertical lines should be sketched at right angles to



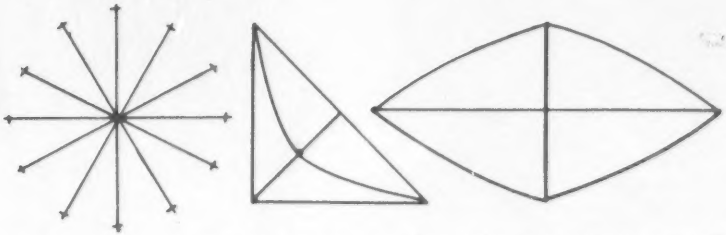




one another. Then equal lengths are marked off on both lines. The draftsman draws the lines of the rectangle through the lines at right angles to them.

The draftsman, then should learn to mark off various angles. A vertical line joining a horizontal line forms a right angle. Other angles may be formed rather simply. If the draftsman marks off equally spaced distances vertically and horizontally, and draws a line between them, this forms a 45° angle.

Draftsmen should also know how to sketch circles and parts of circles or arcs. Circles can be sketched easily by marking off the vertical and horizontal axes, or intersecting lines. Then angled lines should be sketched in—all intersecting at one point. The length of the radius should be marked off on a piece of paper and used to measure each of the lines. The lines between the points should be sketched in.



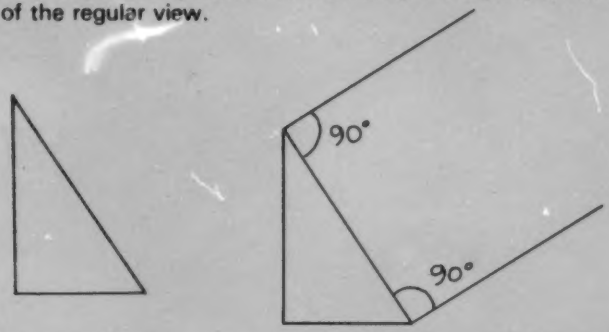
An arc, or part of a circle may be sketched by making a right angle. A chord is a straight line drawn between two points of a circle. Then a line the length of the radius should be drawn between the two legs of the angle. This line should be divided in half and a line should be sketched between the dividing point at which the two legs of the angle meet. This line should be divided in half. A curved line should be drawn from the tip of one leg through the half-way point to the tip of the other leg. This will be the arc.

An ellipse is a curve which resembles a squashed circle. It may be sketched by drawing two intersecting lines at right angles. Equal sized units should be marked off on both lines. Curved lines should be sketched between the outer points of each line.

Once these geometric shapes have been sketched, a draftsman is ready to construct orthographic projections and auxiliary views. When an object is drawn, it is usually necessary to show more than one view, or one side of it. In fact, any object may be looked at from six different sides. A person may look at the object from the front side, the back side, the top, the bottom, the left side and the right side. In drawing, it is often necessary to show several views at the same time. This can be done by

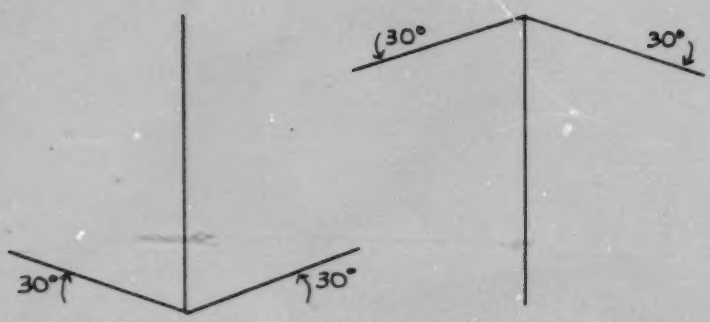
orthographic projection. Suppose that each view of the object is projected onto a side of the box. Although six sides of an object may be drawn, not all sides of an object are always included. Usually no more than two or three views are given. In drafting, the top view is placed directly above the front view. The right side is placed at the right of the front view, etc.

Often in drawing, the depth of the top view will be transferred to the side view. When an object to be drawn is slanted or cut on an angle, the usual sort of drawing does not show its true shape. For instance, neither view really gives a picture of the object. The top view does not show the angle at which it is slanted; the side view does not show how deep the object is. An *auxiliary view* adds depth to the object. Let's see how auxiliary views are drawn. First a view of the object is prepared. This is called the "reference view" or "reference plane". Then the sloping side is drawn using lines at right angles to the cut line. The angled surface then is prepared. Other views and other projections usually are not included. The auxiliary view is almost always on top of, and to the side of the regular view.



Besides constructing auxiliary views, draftsmen must be able to construct three view sketches. Objects shown with three views have the front, top and right sides drawn in. First, the distances should be sketched off. Then each of the views should be blocked in. Principal measurements and details are drawn. Measurements for details are sketched. Finally, circles and arcs are drawn in.

Isometric sketches are also used by draftsmen. Isometric drawings show an object as it really appears. Lines are drawn either as long as they are on the object or to some appropriate scale. Vertical lines show upright edges. Isometric drawings have three base lines. One of the lines is upright; the others are placed 30° away from the horizontal. Isometric circles are not difficult to draw. First, the two 30° base lines should be drawn. Next, lines AD and AE, parallel to each, are drawn through the end points of the lines opposite. These two lines will intersect at point A. Draw two



lines, BF, BG, 60° to the horizontal on each side of the horizontal through the base point, B. Draw lines AH, AI, parallel to each of these lines through each point where the two sets of parallel lines meet the isometric square. These arcs, when they are connected, will form an isometric circle.

GEOMETRIC CONSTRUCTION

Once the draftsman knows some of the basic steps of freehand drawing, the next process to learn is *geometric construction.* There are several steps which are used in all geometric constructions. Draftsmen draw straight lines between two points with pen or pencil and a straightedge. They draw lines parallel to other lines through given points. They bisect lines; that is, they divide them in half. Also they draw lines perpendicular to other, given lines.

Simple Lines

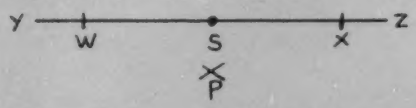
Drawing a straight line between two points is rather simple. The draftsman lays a straightedge between the points and runs a pencil or pen along the straightedge from one of the points to the other.

Drawing a line parallel to a given line through a point is a little more difficult. The draftsman takes a compass and draws an arc with point P as center intersecting YZ at some point X. Then the draftsman sets the compass on X and draws an arc through P and through point W on the line. Line PW is drawn. The compass is adjusted so that it has a width of WP and is set on X. The arc is then drawn. The highest point of the arc A is connected with P, and this connecting line, PA, is the parallel.

Perpendicular Lines

Draftsmen also construct perpendicular lines. Perpendiculars may be constructed with either compasses or triangles. If the

draftsman wishes to use a compass and line YZ, the compass will be set so that it makes an arc which cuts YZ at two points, WX. The center of the arc, where the compass is set, is called S. Then the compass is adjusted so that it has a width greater than 1/2 WX. The compass is set on point W and then on point X, and arcs which intersect are marked off. The point P at which they intersect should be marked. A straight line should be drawn from P to S. This line, PS, is the perpendicular.



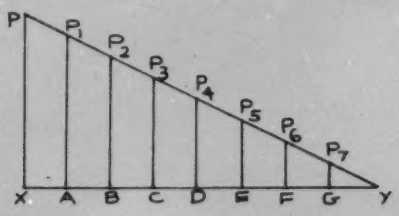
A perpendicular can also be marked off using a triangle and a T-square. The T-square and triangle should be placed so that the given line exactly coincides with one of the sides of the triangle. Then slide the triangle along the T-square until the given point is lined up on the other side of the triangle. The line along the triangle between the point and the given lines is the perpendicular.

Bisecting Lines

A straight line may be easily bisected. Let's see how this is done. If line XY is given, then the compass should be set so that it is wider than 1/2 XY. With X as a center, an arc should be marked off which intersects XY and continues to the other side. Another arc should be marked off with Y as center. The two arcs will intersect at S and T. The line from S to T should be drawn. ST will intersect XY at R. R will be the point of bisection, the half way point of XY.

Dividing Lines Into Equal Parts

It is also easy to divide a given line into any number of equal parts. Suppose there is a line XY and the assignment is to divide the line into 7 equal parts. The draftsman will construct a perpendicular at X. Then a ruler is laid out between Y and the perpendicular. Seven equal units will lie between point P on the perpendicular and Y. These units may be quarter-inches, half



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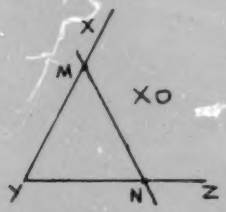
inches, 3/8 inch units or any other convenient unit. A PY is marked off, and each of the units on PY is marked. Then perpendiculars are drawn from each of the points to XY. The points A, B, C, D, E, F where these lines intersect will divide XY into 7 equal parts.

Angle Construction

Draftsmen also construct angles as well as lines. Draftsmen measure angles with a protractor. The protractor is set along the line to be measured so that the given line is on the base line of the protractor (running between 0° and 180°). The point of the desired angle is marked with a pen or pencil, and the pivot point, the center of the protractor, is also marked. Then a line is drawn joining these two points.



Once an angle is given, the draftsman may wish to bisect it. The given angle, say XYZ, is taken. A compass is set to some convenient width, and an arc is drawn intersecting line XY at M and YZ at N. The compass is set to some width greater than 1/2 MN and an arc is drawn with M as the center. Then the compass is set on N and the process is repeated. The two arcs will intersect--say at O. When line OY is drawn, it will bisect the angle XYZ.

Triangle Construction

Draftsmen also construct triangles. Suppose the sides are called X, Y and Z. The draftsman draws one of the sides. Then the compass is adjusted to the width of Y and the compass is set on one of the sides of X. An arc is drawn. The compass is set to the length of Z and set on the other end of X. Another arc is drawn. Where the two arcs intersect is the third corner of the triangle. Sides Y and Z are drawn from that point.

An isosceles triangle is fairly easy to construct. Isosceles triangles have two equal sides. The base line of the triangle is drawn. Let's say the base is line XY. Then the legs of the compass should be adjusted to the length chosen for the two equal sides. These let's call sides XZ and YZ. One compass leg is set on X and an arc turned. Then it is set on Y. Where the two arcs intersect is Z, the

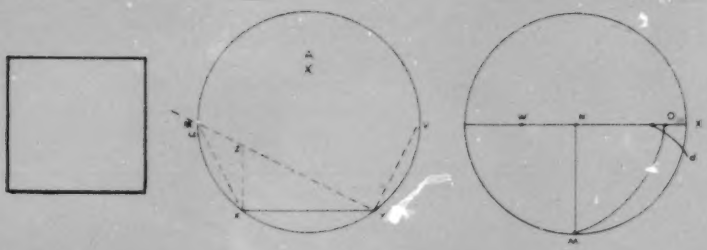
third corner of the triangle. The last step then is to draw XZ and YZ.

An equilateral triangle is one which has all sides equal. Equilateral triangles may be constructed as are isosceles triangles. First, the draftsman draws the base line, XY. Then the compass legs are set equal to XY. The compass is set on X, an arc is marked off and the same on Y. The point at which the two arcs intersect is point Z, the third corner of the triangle (XY = XZ = YZ).

Polygon Construction

Draftsmen also construct polygons. Polygons are closed geometric figures with more than three sides. There are several different kinds of polygons. Squares are four-sided figures. Each side is equal and each angle is a right angle. A pentagon is a closed figure made up of five closed lines. A hexagon is a polygon with six closed lines. An octagon has eight sides. Let's practice constructing these—first with a side given, and then in a given circle.

Suppose that side XY is given and the assignment is to construct a regular pentagon—that is, a pentagon on which all sides are equal.



First at X, the draftsman draws XZ perpendicular to XY and equal to 1/2 XY. Then YZ is drawn. It should be extended to a point M so that the line MZ is equal to XZ. The draftsman takes a compass and sets its legs so that they equal MX. The compass is set at X and an arc is drawn. Next it is set on Y and an arc is drawn. The arcs will intersect at A. The radius AX is left on the compass and is used to draw a circle with a center at A. Then the compass is readjusted to length XY, and points U, V, W are marked off.

Suppose that a circle is given and the draftsman is told to draw a pentagon within it. First, diameter XY should be drawn. Then on XY, a perpendicular radius WN should be drawn. Line NY should be bisected at M. The compass should be set to MW. It should intersect XY at some point O. Then the compass should be set on

W. An arc should be drawn that intersects the circle at P. The line from W to P is one side of the pentagon. Points should be stepped off on the circle using the compass set to width PW.

Hexagon Construction

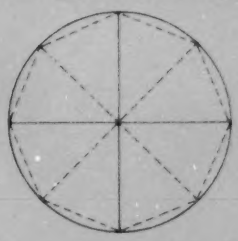
Draftsmen also construct a great many hexagons. Let's see how they are constructed. First, take a line, XY, of known length and construct a regular hexagon, one with equal sides and equal angles.

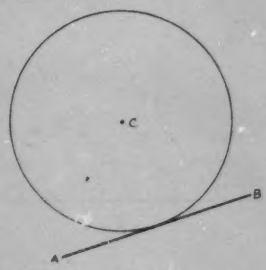
A hexagon may be constructed in a given circle by adjusting the legs of the compass equal to the radius of the circle. The draftsman steps off six equal arcs around the circle. Then chords are drawn between each of the points at which the arcs cross the circle. These chords form a regular hexagon. On hexagons, the distance between two opposite corners is called the distance across the corners. The distance between two opposite sides is called the distance across the flats.

If the distance across the flats is given, the draftsman draws a circle with a diameter equal to the distance across the flats, then places the 30°-60°-90° triangle on the T-square and marks off tangents to the circle.

Octagon Construction

Another figure which is frequently drawn is the regular octagon. Regular octagons have 8 equal sides. An octagon may be drawn in a circle by first drawing two diameters at right angles to each other. Each angle should be bisected and radii drawn. Chords should be drawn between the points where the radii touch the circle. The figure formed will be a regular octagon.





Other Geometric Patterns

Circles and ellipses are still other geometric shapes which draftsmen often must construct. Draftsmen face several problems constructing circles. One of them is to construct circles through three points not on a straight line. Another is constructing a circle

tangent to circles. (A tangent is a straight line which touches a circle at one point.)

ORTHOGRAPHIC DRAWING

Having considered the basic geometry of drafting, we are now ready to look at orthographic drawing in more detail. Orthographic projection can best be imagined as being similar to having an object suspended in a glass box. Imagine that each view, each side of the object, is projected onto the walls of the box. Further, imagine that the walls of the box are open and laid out flat. This, then, becomes an orthographic projection of the object.

How a draftsman draws the surface of an object on a plane is called the problem of *projection*. There are several rules for projection. Straight lines parallel to a surface of projection will appear in its true length. Straight lines perpendicular to a surface of projection will appear as points. Straight lines at acute or obtuse angles to a project surface will appear shorter than they really are. Surfaces follow the same rules as lines. Curved lines have special rules.

Once a draftsman knows the shape of an object and how it will be projected, the drawing must be set up. The first step is to draw center lines. These are drawn as thin broken lines. They are set up at right angles to each other. Center lines divide a drawing into what are called, "axis of symmetry". This is done whenever that which lies on one side of the axis is a mirror image of whatever lies on the other side. They are the first lines to be drawn. Secondary center lines are used for drawing parts which are in themselves symmetrical.

Hidden lines are drawn to indicate parts of an object which cannot be seen. Every part of an object must be described, even those which are not directly visible. Hidden lines are light, dashed lines. Hidden lines begin at the point on the object at which the feature begins. There are several rules for drawing hidden lines. A space should be left between a visible line and the first dash of a hidden line. If a visible line and a hidden line appear at the same spot, the visible line should have a dash at the intersection.

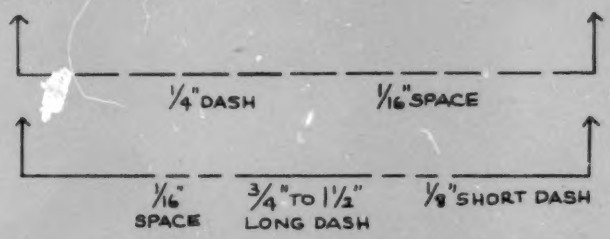
Oblique drawings are drawings made on three axis—two of which are at 90° to each other and the third at any chosen angle. One surface in an oblique drawing is always shown parallel to the front plane, shown facing the viewer. Unlike isometric drawing, oblique drawing always shows one face as it really appears.

With oblique drawings, draftsmen can give clear pictures of objects with uneven surfaces. There are two main things to remember in making oblique drawings. The most uneven surface

should be in front. Secondly, the longest side should be parallel to one of the two right angled axis. Oblique lines are the lines in the drawing which are not in the front plane. Angles in the front plane, the picture plane, are drawn in their real size. The others should be drawn by locating the lines which intersect to form them. Circles in the picture frame should be shown as ellipses. Ellipse templates may be used.

SECTIONAL VIEW DRAWINGS

Once draftsmen are able to do various types of projections, the next part of drafting is making *sectional views*. Sections are drawn when many parts of an object are hidden from view and are too complex to be represented by hidden lines. Sectional views show the object as it would look if it were to be cut in two. Just as objects have three dimensions, so there are three kinds of sectional drawings. Front sections show the object parallel to the side facing the viewer. Horizontal sections show the object parallel to the horizontal. Profile sections show the object parallel to the profile, "along the side". The edge of the cutting plane should be indicated in drawings by the cutting-plane line. It is shown by two lines.

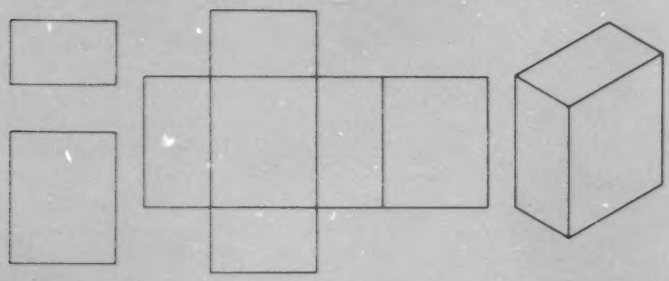


Sections may be drawn orthographically, with two or three flat views, isometrically—on a vertical axis with two axis at 30° to the horizontal, or obliquely—with two axes at right angles (one horizontal; the other vertical) and a third axis at some angle to those.

There are several types of sections. A full section shows the object cut exactly in half down the center. A half section is formed by cutting the object in two planes so that 1/4 of the object is removed. The two cutting planes are set at right angles to one another. An offset section is one in which the cutting plane is moved out of a straight line in order to avoid some detail in the object. Broken out sections are sections which show some part of the outer surface of the object removed, but not as much as a half section. A revolved section takes a part of the section which is at right angles to the cutting plane and turns it so that it is parallel

to the cutting plane. A phantom section uses hidden lines to show the interior and exterior of an object at the same time.

Another thing draftsmen do, which requires all the techniques discussed here, is pattern design. Patterns are used in many different places. Almost all sheet metal products begin on a draftsman's layout table. Further, nearly all packages—such as cardboard boxes, cigarette packages, soft drink bottles and milk cartons—begin by first being drawn by draftsmen. Nearly all of them are one of the geometrical solids previously described.



Prisms

Prisms are slightly more difficult to develop. The length of the pattern is measured by what is called the stretchout line. The stretchout line is the shortest distance around the base of the prism. Next crease lines at right angles to the stretchout line are drawn. They should be as long as, or in proportion to, the length of the edges in the prism. Then, on the line, lay off the distances between the crease lines.

Oblique prisms are developed in the same general fashion. The stretchout line is calculated by taking a right section of the prism, and the distance around the section is the length of the stretchout line. The plane should be perpendicular to the edges. An auxiliary view of the section is drawn. On the stretchout line, the fold lines are drawn perpendicular to it, and as long as the adjacent face of the prism is high.

Cylinders

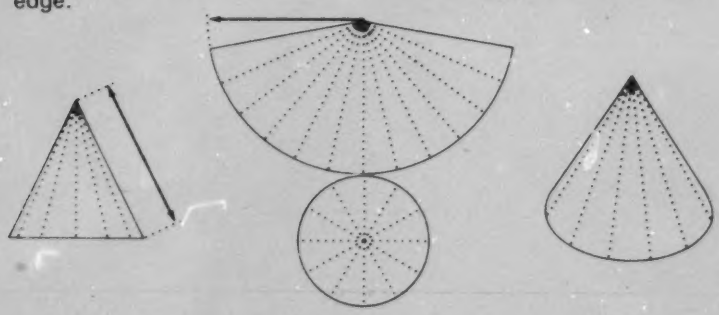
There are many different sorts of prisms and other surfaces to develop. One of these is the cylinder. A cylinder can be thought of as a prism with a countless number of sides. The stretchout line for the cylinder will be the distance around its base. On the stretchout line draw as many parallel vertical lines as necessary. Usually, the lines will not be closer together than 1/4 inch. A truncated cone, a cone whose top has been cut off at an angle, may be developed by drawing the stretchout line and then

vertical lines to varying heights. At both ends of the stretchout line the vertical lines will be short; then they will gradually grow longer until they are full length in the middle. On each side, vertical lines equally distant from the end of the stretchout line will be the same length.

Draftsmen often lay out duct and plumbing work. In doing so, they draw cylinders and truncated cylinders as parts of pipe elbows. Usually, pipe elbows are two piece or four piece constructions. Two piece elbows, or square elbows, are joined at 45° angles. Both parts of the elbow may use the same pattern, which will be a standard truncated cylinder pattern.

Triangles, Pyramids And Cones

The previous figures have all been made up of rectangles. Now let us look at the figures which can be laid out using triangles, pyramids and cones. Pyramids and cones are drawn with curved stretchout lines rather than straight ones. The first step in laying out a pyramid is to find the true length of the edges. This will be the length when it is parallel to the plane facing the viewer. The true length is used as a radius to lay out the stretchout curve. The base lines then are marked off as chords on the stretchout curve. If the pyramid is truncated, the true lengths of the truncated sides are drawn, and the lines are extended until they intersect. With this extended length as a radius, a stretchout curve should be drawn; the bases should be drawn in as chords. Then the truncated edges should be drawn in parallel to the base edge.



Cones may be thought of as pyramids with a countless number of sides. In practice a series of radius lines 1/4-1/2 inch apart at the base are drawn to intersect. A cone is laid out with a stretchout curve whose radius is equal to the slant height of the cone. If the cone is cut off straight across, a second arc should be drawn with a radius equal to the distance from the sliced off edge to the tip of the cone.

What if the cone is truncated, or cut off at an angle? First, the height of the full cone is found and used as a radius for the stretchout curve. Then each radius line is calculated to its true length on the truncated cone, and its point of truncation is marked. Then a curve is drawn through the points of truncation.

MATHEMATICS

INTRODUCTION

As a draftsman, you must know how to measure distances accurately, scale distances on a drawing, reduce fractions to decimals and find the area of a plane figure or the volume of a solid. Unless you have a firm grasp of the basic operations of arithmetic, you cannot expect to be able to use mathematics successfully. If you can use numbers accurately and easily, you will find that mathematics is less difficult than you may have been led to suppose.

Mathematics is very much like mechanical drawing in that, once you have a grasp of the principles, it becomes a matter of skill which can be acquired by practice. If you have never had occasion to use algebra, geometry, trigonometry or logarithms, you will need to practice in order to develop the necessary skill. When you are using these tools steadily on the job you will find that their use becomes almost second nature to you. Problems which would otherwise be extremely complex can be solved quickly and with a minimum of effort.

USE OF SCALES

Any graduated instrument (like a ruler) is called a scale, although actually the set of graduations on it is the scale. When we speak of the scale of a drawing, we mean the ratio of the measurements on a drawing of an object to the same measurements on the

object. For example, suppose you are drawing an object which is 24 inches long, but there is only room on your paper for a drawing 12 inches long. If the object is drawn to scale in this space 2 inches on the object will be represented by 1 inch on the drawing. You could, of course, draw the object 6 inches long on the paper, and then 4 inches on the object would be represented by 1 inch on the drawing. The drawing would be called a quarter-scale drawing.

Notice that a half-scale drawing is not half the size of the object. It is only a quarter the size of the object because the dimensions in each direction are halved. For the same reasons, a quarter-scale drawing is only 1/16 the size of the object.

A draftsman must deal with problems of scale constantly. When measuring distances with scales and when dimensioning drawings, common fractions and decimal fractions are used. There will be times when, in order to determine the dimensions of a part, one must add, subtract, multiply or divide fractions. Sometimes it will be necessary to change common fractions to decimal fractions (usually called decimals) and vice versa.

Almost every computation which involves determining an unknown value on the basis of known values involves the solution of proportional equations. For example, if "b" represents the length of the base of a rectangle and "h" represents the height, then the formula for the area A is: $A = bh$. This is itself a proportional equation — that is, an equation showing two equal ratios, as: $\frac{A}{1} = \frac{bh}{1}$. It follows that, if $A = bh$, then $b = \frac{A}{h}$. This is likewise, of course, a proportional equation containing two equal ratios, as:

$\frac{b}{1} = \frac{A}{h}$. It follows again that, if $A = \frac{b}{h}$ then $h = \frac{A}{b}$. This again, is a proportional equation.

Practically any problem involving the conversion of a measurement expressed in one unit to the equivalent in a different unit is solvable by proportional equations. Similarly, if you know the quantity of a material required to produce a certain number of units of product, you can determine this by proportional equations.

In short, it is difficult to imagine any linear mathematical computation involving the determination of unknown values on the basis of known values that is not solvable by a proportional equation.

Your knowledge of equations need not extend beyond that required to solve linear equations — that is, equations in which

the unknown appears with no exponent higher than 1. The equation $\frac{4X}{7} = \frac{15}{6}$ for example, is a linear equation because the unknown (technically known as the "variable") X appears to only the 1st power. The equation $\frac{X^2}{2X} = -1$, however, is not a linear but a quadratic equation, because the variable X appears to the second power.

An angle may be roughly defined as two straight lines which lie in the same plane and meet at a point. The point of meeting is called the apex of the angle, and the two straight lines are called the sides.

It may be said that the size of an angle is designated according to the size (measured in units of arc) of the arc (segment of the circumference of a circle with center at the apex) lying between the sides. (The circumference is the whole distance around a circle.)

The largest conceivable angle is the angle comprised in a single complete circle. Trigonometrically speaking, angles larger than this are conceivable.

The unit of arc most commonly used to measure angles in the English-speaking countries is the degree, representing a 360th part of the circumference of the total circle around the apex. A degree is subdivided into 60 minutes, each of which contains 60 seconds. Seconds are subdivided decimally into tenths, hundredths, and so on.

Angular measurement in grads is an aspect of the metric system of measurement, and is used mostly in those countries which make general use of the metric system. The circumference of the complete circle is divided into 400 equal intervals called grads, each of which is subdivided decimally into tenths, hundredths, thousandths and so on. As there are 400 grads in 360 degrees, it follows that there are $\frac{400}{4}$, or 100 grads in 90 degrees, and 1 grad, therefore, equals 0.9 degrees, which equals 54 minutes.

To convert a measure expressed in terms of one unit to the equivalent in terms of a different unit is, when you know the ratio between the units, a simple proportional equation problem.

Let us suppose, for example, that you want to convert a linear distance in engineer's measure (feet and decimals of feet) to the equivalent in carpenter's measure to the nearest $\frac{1}{8}$ inch. Suppose that the original distance is 12.65 feet (this means, "12 feet and 65 hundredths of a foot"). In carpenter's measure the foot is divided

into inches, or twelfths of a foot. You want to determine first, then, how many twelfths of a foot there are in 65 hundredths of a foot. The original ratio is $\frac{12}{100}$. The proportional equation solution is:

$$\frac{X}{65} = \frac{12}{100} \qquad X = \frac{12 \times 65}{100} = \frac{780}{100} = 7.8$$

Therefore, there are 7.8 inches in 0.65 foot. The next step is to determine how many eights of an inch there are in 0.8 inch, that is, in $\frac{8}{10}$ tenths of an inch. The initial ratio is $\frac{8}{10}$, and the proportional equation solution is:

$$\frac{X}{8} = \frac{8}{10} \qquad X = \frac{8 \times 8}{10} = \frac{64}{10} = 6.4$$

Therefore, there are (rounded off) $\frac{6}{8}$ inch, or $\frac{3}{4}$ inch, in 0.8 inch. In 12.65 feet, then, there are 12 feet 7-$\frac{3}{4}$ inches to the nearest $\frac{1}{8}$ inch.

In converting from engineer's to carpenter's measure, or vice versa, you may, when working to the nearest 0.01 foot or $\frac{1}{8}$ inch, use the following tables of decimal equivalents of the common carpenter's-measure subdivisions of the inch.

1 in.	=	0.08 foot
2 in.	=	0.17 foot
3 in.	=	0.25 foot
4 in.	=	0.33 foot
5 in.	=	0.42 foot
6 in.	=	0.50 foot
7 in.	=	0.58 foot
8 in.	=	0.67 foot
9 in.	=	0.75 foot
10 in.	=	0.83 foot
11 in.	=	0.92 foot
1/8 in.	=	0.01 foot
1/4 in.	=	0.02 foot
1/2 in.	=	0.04 foot
3/4 in.	=	0.06 foot

Using these values you can convert decimals of a foot to inches carpenter's measure, or inches carpenter's measure to decimals of a foot, very easily. To convert (for example) 0.37 foot to inches carpenter's measure you have: 0.33 foot = 4 inches

$$\frac{0.04 \text{ foot}}{0.37 \text{ foot}} = \frac{1/2 \text{ inch}}{4\text{-}1/2 \text{ inches}}$$

To convert (say) = 7-3/8 inches carpenter's measure to engineer's measure you have: 7 inches = 0.58 foot

$$\frac{3/8 \text{ inch}}{7\text{-}3/8 \text{ inches}} = (3 \times 0.01) = \frac{0.03 \text{ foot}}{0.61 \text{ foot}}$$

For a great many types of conversions there are tables in which you can find the desired values by inspection. Such tables may be found in drafting and engineering handbooks. These handbooks frequently contain tables of constants in which a large number of conversion factors are given. A conversion factor is a number which, multiplied by a value expressed in terms of one unit, will produce the equivalent value expressed in terms of a different unit. The factor for converting linear feet to miles, for instance, is 0.00019. If you multiply 5280 feet by 0.00019, you get 1.00 miles.

When you know the ratio between two different units, you can easily work out your own conversion factor. For example: You know that the ratio of degrees is mils to $\frac{9}{160}$. The conversion factor for converting degrees to mils is the number of mils in 1 degree, which is $\frac{160}{9}$, or 17.8. The conversion factor for converting mils to degrees is the number of degrees in a mil, which is $\frac{9}{160}$, or 0.0562.

Some typical conversion factors are:

Linear feet	x	0.00019	=	miles
Linear yards	x	0.0006	=	miles
Square inches	x	0.007	=	square feet
Square feet	x	0.111	=	square yards
Square yards	x	0.0002067	=	acres
Acres	x	4840.0	=	square yards
Cubic inches	x	0.00058	=	cubic feet
Cubic feet	x	0.03704	=	cubic yards

Typical equivalents include the following:

U.S. gallons in 1 cubic foot	=	7.4805
Feet in 1 meter	=	3.280833
Inches in 1 meter	=	39.37
Square feet in 1 acre	=	43560.00

Raising a number to a power means multiplying the number by itself a certain number of times. Taking the root of a given number means determining what numbers must be multiplied by itself a certain number of times to result in a given number. Any number is a higher power of a given root; the number 9, for example, constitutes 3 raised to the second power, commonly called "3 squared," which is written 3^2. It follows that the square

root of 9 is 3. A particular power is indicated by a small numeral called an exponent; the small 2 on 3^2 is an exponent. A particular root is indicated by the so-called radical sign $\sqrt{}$, together with a small numeral called the index of the root. The expression $\sqrt[3]{27}$, for example, means "the cube root of 27". For a square root, however, the index symbol is usually left off the radical sign.

A graphical presentation can usually be grasped much more quickly and clearly than a table of figures. Graphs, which are sometimes called charts or diagrams, are consistently used in engineering work, publications and as visual aids.

There are many kinds of graphs. They may be divided roughly into two categories — engineering graphs and illustrative graphs. A draftsman in any of the engineering fields should know the basic types of coordinate paper, how to plot accurately and how to draw curves. The illustrator should have this knowledge and these skills, and should also know how to present the information in the form of visual aids to be used in briefings and training sessions.

ENGINEERING DRAFTING

INTRODUCTION

Besides drawing plans for buildings, draftsmen also draw maps for engineers. These maps may be of large areas, a lot or subdivision. They further prepare maps of roadbeds, pipelines and subdivisions. Sometimes they are asked to lay out a water supply system, sewer, gas piping, underground electrical or telephone system. The draftsman takes surveyor's field notes or aerial photographs and translates them into drawings and designs. To do this, the draftsman first must have some idea of how a survey is done and what symbols are used. These include such surveying concepts as benchmarks, which are permanent points from which measurements are made, and magnetic North, a point toward which the compass needle is attracted. True North is the exact direction of the North Pole. Further, draftsmen must be able to read legal descriptions of land. These might include such information as acreage enclosed by boundary lines, the location of boundaries (including the angle between each boundary line and true North), the length of boundaries, the location of monuments for the corners of the property, easements, (which are the rights to use the property held by someone other than the owner), the name of the property owner, the names of owners of adjacent pieces of property, roads or railroads crossing the property, ponds and waterways, fences and walls and the scale of the map. In short, an engineer's map is very much like a plot plan. Once the major features are located, the draftsman then draws in the contour lines (lines drawn between points which have the same elevation). Contours are made by marking the elevation readings taken by the surveyor on the map. Points of equal elevation are connected with lines drawn between them. This operation is more detailed than it might first appear. When a draftsman is making a topographic map of an area, the major features of a piece of land are laid out and a grid system is constructed. The *grid system* is a net of parallel lines 50 to 100 feet apart to which a second set of perpendicular lines is placed so that a series of small squares is formed. Elevations are taken of the points of each of the squares. The points which have identical elevations within 5 feet should be joined by smooth, curved lines.

CONTOUR LINES FOR SUBDIVISIONS

If contour lines for a subdivision are being laid out, the lines indicating differences of 1 foot elevation should be drawn if the grade is 2 percent or less. If the grade is between 2 and 4 percent, contour lines should be between points 2 feet different in

elevation. Where the grade is greater than 4 percent, contour lines should be spaced between 5 foot intervals. Contours of nearby creeks or gulleys which might overflow and cause flooding should also be given.

DRAWING PLOTS

Engineering draftsmen often draw up plots for city lots and subdivisions. When a draftsman lays out lots and subdivisions, one of the boundaries is measured off. The angles turned, as recorded in the field notes, are measured off onto the drafting sheet with a protractor. If a subdivision is being laid out, the draftsman repeats this process for each tract. The acreage in the tract is calculated. Adjacent streets are laid out and drawn. In order to calculate the area enclosed by a given group of boundary lines, the area is drawn and then divided into a series of triangles. The area of each triangle is calculated. The areas of all the triangles are added together to find the total area of the plot. The formula for the area of a triangle is $A = \sqrt{s(s-a)(s-b)(s-c)}$.

A = area of the triangle
a = one side of triangle
b = second side of triangle
c = third side of triangle
2 = one-half of the sum of three sides

This process for dividing an area into triangles is called *triangulation*. Once a plot can be drawn from field book data, the draftsman is ready to draw a preliminary subdivision plot. The first step is to draw existing street and property lines, then proposed street and property lines. Existing surveying monuments should be shown at the property lines. All distances should be drawn to scale and lengths marked. After the streets and lots have been indicated, the set-back-line (the line showing the distance buildings are to be set back from the street) should be drawn. Usually, in subdivisions, lots are 50 feet wide in the middle of a block and 60 feet wide on the corners. Easements on the property are shown. Where curves are drawn, such as at street intersections, the radius of the curve is marked. Any other major features of the area should be marked in and noted. The scale used and the symbols used are shown and, finally, an engineer must sign and seal the map.

A final subdivision plot is more complicated than a preliminary subdivision plot. This plot is usually drawn on linen. Existing property lines and streets are drawn in dashed ink lines. Property easements should be drawn in and labeled and their distances from property corners should be noted. The set-back-lines and adjacent subdivisions should be drawn in. Lot and block numbers

are added. Septic tanks, sewer, gas and water lines; county roads, streets and culverts; street intersections and redivided subdivisions should be drawn in. The owners of neighboring plots of land should be shown. The scale used should be noted and "North" should be indicated with an arrow.

UTILITY SYSTEM MAPS

Besides maps of subdivisions, maps and plots of utility systems such as water, wastewater distribution and gas systems are often made. Utility systems are fairly easy to draw. First, streets and easement lines should be drawn in; next, property lines. Detail drawings of the system should be made at those points where new piping will be attached. Such detail drawings should show the size and type of pipe, its location and depth. Detail drawings of existing mains should show valves, hydrants and major services. Features which will be replaced or repaired, as walks, driveways, culverts, curbs, pavements, fences, signs and bridges should be drawn. Where the plat is continued on more than one sheet, reference lines should be drawn so that the sheets may be lined up with each other. In water system plats, a detail drawing or drawings should be made which show the water meter, valves, hydrant locations, the trenching used to lay the pipes, the amount of backfill used, the paving replacements used and any special valve boxes. In the main drawing, the size of the water mains and kinds of fittings required should be noted. Fire hydrants should be drawn in. Likewise, the location of service boxes should be shown. Also, profile drawings of the streets or easements under which pipe will be laid should be made. A *profile drawing* is a drawing which shows a side view of the ground through which a pipeline will be placed. Once the drawing is made it should be labeled. First, the street name, then, sizes of mains, valves and hydrants should be written in. The "North" arrow is indicated. Any streets, walks, driveways and culverts which will be crossed should be labeled. Note all high points where air is likely to be trapped. Finally an engineer's signature and seal should be obtained.

SEWER SYSTEM DRAWINGS

Sewer and storm sewer systems are also drawn frequently. Sewer line plans are drawn as frequently as any other utility system plan. First, street and easement lines are put in. The property lines, including the name of the owner, are shown. The draftsman should make a detail drawing of those places where the new system will tie into the existing system. These drawings show the details of the present system and include information about the size, location and type of pipe presently used. The elevation of the

pipe and the the direction of flow should also be included. This same information should be given for new mains. The location of new services and new manholes should be drawn in. The draftsman should take the survey field notes and note the station numbers as they go up stream. Also, all items which will be repaired or replaced during construction should be noted. This includes trees, walks, driveways, culverts, curbing, paving, utility lines, fences, signs and bridges. Detail drawings should be made of different parts of the system—typical manholes, service connections and so on.

Plans and profile drawings of the system should also be made. The plan for the system should be drawn large scale, with the main centered on the paper. The distance between the main and the center of the road should be shown. The size of fittings and pipes should be noted. Places where new service will be located should be indicated. Profile drawings then should be made. These show the present ground line and the proposed ground line. A manhole should be drawn each 500 feet or at each street intersection. The elevations from each of the manholes should be calculated. All bedrock elevations should be calculated to locate the depth of the bedrock underground.

Once the system is drawn it should be labeled. First, the street names are written in. Main sizes are shown and the direction of flow is marked. The North arrow is shown. The scale of flow should be marked in. Then trees, walks, sidewalks, driveways and culverts which are in the path of the system should be marked. Finally a contour map of the area should be drawn to show the direction of flow. (Most sewer systems flow by gravity. Because of this they should be laid so that the direction of flow is downhill).

Besides sewer systems, draftsmen also draw up storm sewer systems. The first step in making plans for a storm sewer system is to draw a map of the area. This should include streets, easement and property lines. Then a topographic map of the subdivision should be made. This should show how water drains from the area and should show what streams, inlets, drainage ditches or existing storm sewer systems collect the water. If a storm sewer system already exists, the map should show what mains, ditches, manholes, etc., are connected to it and what is their capacity. The new features and how they are to be connected to the old system should be drawn in. Any features of the area which will be disrupted by the system should be noted. This includes such things as trees, walks, driveways, culverts, ditches, streets, bridges and so on. Detail drawings should be made of typical features of the system such as manholes,

culverts, headwalls, inlets, trenching, laying and backfill, paving replacement and ditch sections. These drawings should show the dimensions of the system.

Once the map of the system is drawn, profile drawings should be made. These should be taken from survey field notes. Station numbers should be marked on the drawing. These numbers should increase upstream. All mains, ditches and inlets should be drawn in profile, and their gradient, which is the number of inches dropped per hundred feet, should be marked off. All manholes should be marked on the profile.

When the drawings are finished, they should be labeled. Street names and names of property owners should be written in. Then the sizes of mains and ditches should be written. Finally, the North arrow should be drawn. The scale and the symbols used on the chart should be noted last. It is then ready for an engineer's signature and seal.

GAS DISTRIBUTION SYSTEM DRAWINGS

Gas distribution systems are another underground utility system which draftsmen prepare. The plans for a gas system are similar to those for any other utility. A map of the area should be drawn. The map should show streets, property lines, easement lines and widths. Lot and block numbers should be written in. Existing and proposed gas mains should be drawn and labeled. Detail drawings showing those points where new gas lines will tie into old gas lines should be made. The size, depth and type of pipe used should be noted. Detail drawings of points where other utility piping systems cross the gas lines should be made to show depth, size, type and location of each of the pipes. Valves should be located at every street intersection so that gas flow can be shut off to allow repairs. All objects in the area which will be crossed by a gas line, such as trees, culverts, streets, curbs, paving and so on, should be drawn and measurements given. Detail sheets should show meters, valves, trenching and backfill and other typical features of the system. Once the drawing is made, it should be labeled. Street names should be written in. The size and type of pipe used in gas mains should be noted. The North arrow should be drawn. The scale and legend used should also be marked. All features of the landscape crossed by the pipe should be noted. The title block should be drawn in, the job number noted and page numbers written in. Then an engineer's signature and seal should be obtained. (Underground electrical and telephone lines should be drawn in the same way.)

CITY STREET DRAWINGS

Draftsmen also often draw plans for city streets. This is somewhat different from drawing plans for a subdivision or for a utility system. Let's see how it should be done. The first step is to draw a plan for the area showing property lines, lot and block numbers. Then a topographic map of the area should be drawn which shows existing pavement, culverts, curbs, etc., together with their elevations. Then, on the plan and profile drawings, the centerline of the street and the paving line should be noted. Station numbers should be written in at appropriate places. Centerline bearings and elevations should be noted and written in. Curbs at intersections should have a radius of 25 feet. The direction of drainage along the curb should be written in. Station numbers should increase from left to right (West to East) and from bottom to top (South to North). Profile drawings should contain the following types of information:

- Existing elevations at the centerline and at the side property lines.
- The finish elevations at both spots.
- Present and finished curb top elevations on both sides of the street.
- Buried utility lines.
- Elevations of intersecting streets.
- The slope, or gradient, of curbs on both sides.
- The size of gutters.

Curbs and gutters should be smooth; there should be no breaks or sharp changes of elevation. *Cut and fill information* should be shown. This information is the difference between proposed and existing elevations. Once this is drawn, streets should be labeled, and the North arrow should be drawn in. Then the scale and symbols used should be written in. The title block should be added and an engineer should sign and seal it.

These are the main projects on which engineering draftsmen work. Although the details of their work will vary from project to project, the main tasks they perform will remain about the same.

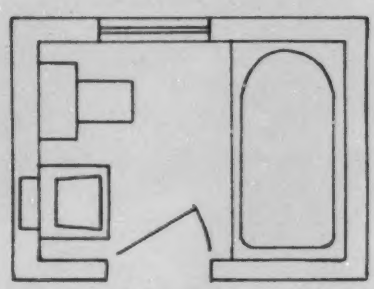
ARCHITECTURAL DRAWING

INTRODUCTION

Architectural drawing is a special sort of drafting in which architects and their assistants draw the designs for buildings and other construction projects. There are a number of tasks architectural draftsmen do which differ from tasks of other draftsmen. Architectural drafting is usually completed on paper which has been cut to one of three standard sizes: 8-1/2 x 11 inches, 18 x 24 inches and 24 x 36 inches. The drawing should have a 1/2 inch margin on the top, bottom and right side, and a 1 inch margin on the left side of the sheet. The margin is indicated by a trim line, which is a heavy black line drawn 1/2 inch away from and parallel to the top, bottom and right sides of the sheet. It should be continued 1 inch away from, and parallel to, the edge on the left side of the sheet. After the trim line has been drawn, the title block is drawn in. The block usually is 1-3/4 by 4 inches but other sizes may be used. Certain information is written in the title block, which may include the type of building drawn, the name and address of the client, the initials of the draftsman preparing the drawing, the initials of the checker, the date the drawing was finished, the job number, the sheet number and the number of sheets used to draw the entire job. Several different lettering formats are used to make architectural drawings. Most architectural draftsmen use either the slanting or the vertical *Commercial Gothic script*. Letters should vary in size. Sheet titles should be 1/4 inch high. Room titles should be lettered in 1/8 inch high. Detail titles should be 3/16 inch high. Notes should be written in letters 3/32 inch high. About 1/8 inch space should be left between printed lines on drawings. Numerals should be made very clearly and distinctly. Fractions should be made with a horizontal slash, and mixed numbers should be written so that the slash falls exactly next to the middle of the numeral.

BATHROOM LAYOUTS

With these general instructions, let's see how some common layouts would appear. As a first example, let's look at a 5 foot 6 inch x 8 foot bathroom layout. First, the draftsman would choose the proper scale. The draftsman would use the proper symbols for bathroom fixtures. The water closet is noted by two rectangles. The lavatory is drawn by a trapezoid inside a square. An oval lavatory is shown by a square containing an oval. A bathtub is denoted by a rectangle which contains a half ellipse, or corner tubs. Medicine cabinets and bathroom mirrors are often placed



directly above the lavatory. Medicine cabinets are shown by a rectangular space set into the wall, usually behind the lavatory. Bathroom mirrors are shown by two thin parallel lines 1/32 inch apart. The linen closet may be simply denoted by a rectangle and labeled "linen". A clothes hamper may be similarly indicated by a rectangle labeled "hamp". Bathtubs come in a variety of sizes, from 4-1/2 to 6 feet. Five foot tubs are most common. Another specific symbol used in drawing bathrooms is the sunlamp, or lamp symbol.

Several things should be considered when designing a bathroom. These are ventilation, lighting, heating and plumbing. Any bathroom should either have a window opening to the outside or an exhaust fan. Bathroom lights should cast as few shadows as possible. Fluorescent lights in the ceiling above the lavatory are one way of achieving this. Heaters should be placed under the window so that cold outside air will be warmed as it enters the bathroom. Plumbing lines should not be any longer than necessary. Sinks less than 18 inches from other fixtures do not need separate plumbing. On the other hand, the water closet must be at least 15 inches away from other fixtures. Vent pipes are shown by hollow circles in walls. Hot water supply lines are indicated by solid lines. Cold water lines are indicated by broken lines. Water heaters are denoted by a large 'O'.

Draftsmen need to be familiar with different wall coverings used frequently on bathroom walls. Plaster and tile are often used. Both of these materials resist moisture well. Other wall coverings which are water resistant include: Plastic-covered wallpaper, corrugated plastic sheets, marble, terrazzo, mosaic tile, glass panels or mirror panels, and, on occasion, wood paneling.

KITCHEN LAYOUTS

Besides bathrooms, kitchens also need to be carefully designed. The kitchen sink should be placed so that it is convenient to the range and refrigerator. Cabinets should be placed properly.

Appliances and storage spaces must be located so that work may be done easily and with as little wasted effort as possible.

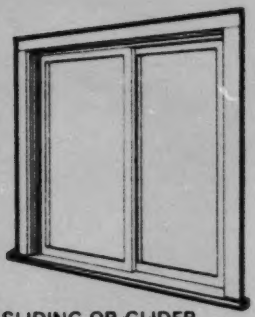
There are three major parts of a kitchen. The first is the space in which food is stored and mixed. The refrigerator and cabinets make up this area. The second part is where food is prepared and utensils are cleaned. This includes the sink, counter tops and drain board. Last, there is the actual cooking area. This space contains the range and oven, and may include space for minor appliances, such as toasters. These three areas should form a triangle. Several symbols are used.

There are several different basic designs for kitchens. Kitchens may be U- or L-shaped. They may be arranged along two parallel walls, a corridor kitchen or along one wall. An island kitchen has an L-shaped layout along two walls. One of the three work areas is set in the middle of the room. No matter how the kitchen is laid out, it should be set up so that the three major centers of the kitchen form a triangle. This "work triangle" should be from 12 to 22 feet around the outer edge.

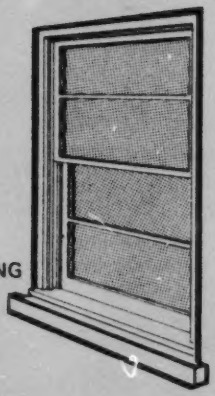
Frequently, several drawings are made of different features of the kitchen. These include drawings and plans for cabinets, electrical fixtures and interior elevations. First, let's see how a typical cabinet might be drawn. The foundation line should be laid out on the sheet. Then the foundation and the wood block should be laid out. A toe space should be left at the base of the cabinet. The cabinet should be drawn about 35-1/2 inches high and 24 inches wide. In order to provide a strong working space, a formica top should be indicated. The top cabinet should be placed 18 inches above the bottom cabinet to leave a working space. The top cabinet then should be 2 feet 6 inches high and 12 inches wide. A gypsum furring strip 1/2 inch thick and 1 foot wide should be placed between the top of the cabinet and the ceiling. Finally, plywood doors and metal hinges should be drawn on the cabinet. The shelves should be indicated, even if only with dotted lines. The next kitchen drawing should show the symbols for various fixtures and the kitchen elevation.

WINDOW DETAIL DRAWINGS

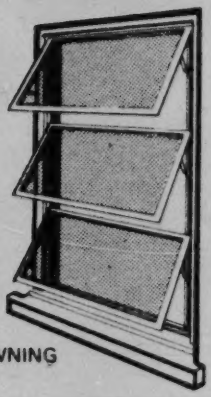
Architects, in making drawings for a house should detail framed walls, doors and windows. Let's look at what is included in a window detail. There are a number of windows commonly used in buildings. Although details will vary among different types, double hung windows are frequently used. A double hung window has two sections which slide up and down in a frame to open and close. The bottom plate is a piece of lumber on which the window rests. Studs 2 x 4 inches should be drawn on both sides. A 2 x 4



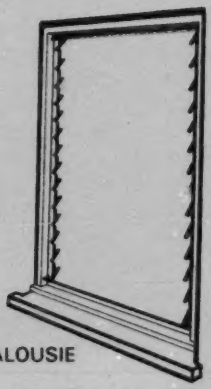
SLIDING OR GLIDER



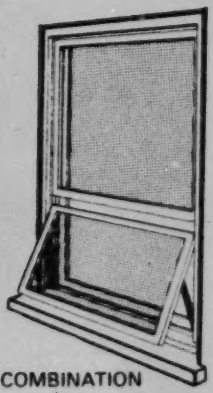
DOUBLE HUNG



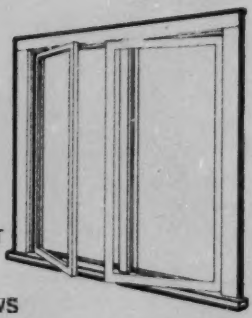
AWNING



JALOUSIE



COMBINATION



CASEMENT

TYPES OF WINDOWS

inch trimmer, a 2 x 4 inch sill across the bottom and 2 x 4 inch headers with 3/8 inch spacers, cripples and top plates should be included. Then the head detail (top part) of the window should be drawn. This would include the drip cap, the exterior casing, the exterior trim, the interior trim, the top jamb and the top rail.

The third step is to draw in the jamb detail (jambs are the sides of windows). Included in the jamb detail are the screen or storm doors, the blind stop, the side jamb, the exterior casing and the side rail. Finally, the sill and rail are drawn. This should include the glass, the bottom rail, the center meeting rail, the stool, the sill and the apron.

ROOF DRAWINGS

Another part of a house which must be carefully drawn is the roof. In order to draw a roof, a draftsman should be familiar with the different types. In any roof there is a pitch and span to draw. Pitch is the amount the roof rises in height for each unit of length. For instance, a pitch of 4 to 12 would mean that for each 12 inches the roof is wide, it rises 4 inches. A pitch of 6 to 12 inches would mean the roof rises 6 inches for each 12 inches of length. In addition, the parts of a roof and the materials which go into it should be shown. As a practice it would be useful to draw an L-shaped gable roof with a 4 to 12 pitch. This should include studs o.c. (on center) 16 inches apart, double plates made of 2 x 4's, ceiling joists, rafters with framing anchors, blocking rafter ends, soffits, rafters, tar paper and shingles. Parts should be labeled with letters 1/32 inch high. At the side of the drawing a list of materials used in the roof should be written out.

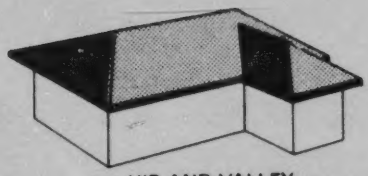
WALL SECTION DRAWINGS

Besides the roof, wall sections also are drawn. These drawings show the concrete foundation and the wooden supports which make up the building. The wooden supports are called the *framing* of a building. Architectural draftsmen are able to draw a framing section. Drawings include the concrete slab, felt between the slab and the sole plate (the pieces of lumber which attach the framing to the slab). The sole plate, which is usually a 2 x 4, should be drawn in. Studs and double plates—the vertical wall members—should be included. The draftsman should indicate that walls be insulated with fiberglass. Phantom sections should show that walls will be covered with 1/2 inch wallboard and that the exterior wall will be finished with #105 siding.

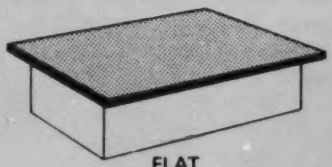
ELEVATION DRAWINGS

In addition to floor plans for specific rooms and views of walls and roof framing, the architectural draftsman produces elevation

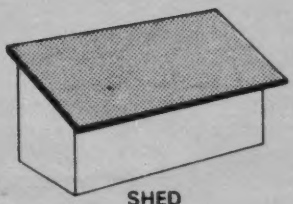
ROOF SHAPES



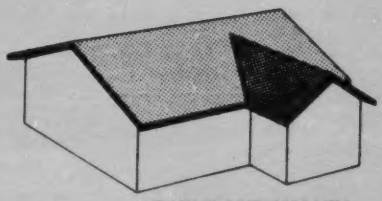
HIP AND VALLEY



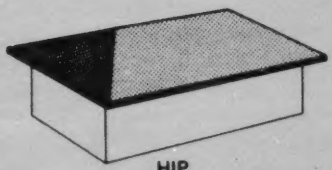
FLAT



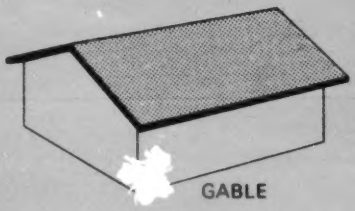
SHED



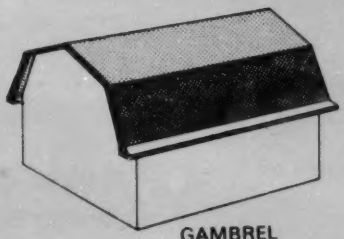
GABLE AND VALLEY



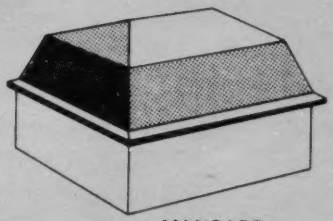
HIP



GABLE



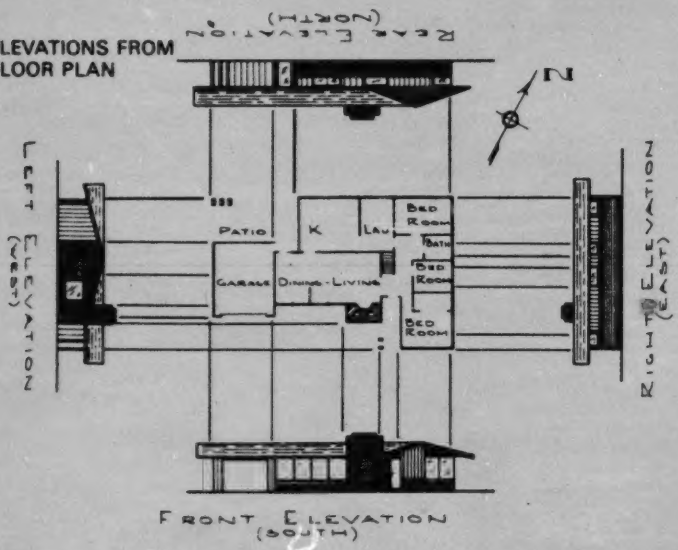
GAMBREL



MANSARD

drawings. These drawings are simply views (pictures) of a given side of a building. In an elevation, each visible feature of the structure is carefully labeled and its dimensions are given. The drawing should be to exact scale. Elevations usually are drawn to a scale of 1/4 inch = 1 foot or 1/8 inch = 1 foot. The first line to be drawn on an elevation is the floor line. The floor line is also a center line and its ends should be extended beyond the sides of the building. A label 'F.L.' should be written on the line. The second line to be drawn is the ceiling line. The ceiling line should be parallel to the floor line. Below the floor line the lower edge of the floor joists line should be drawn in. Last, the ground line should be shown. The ground line should be extended beyond the walls and labeled 'G.L.'. The floor, floor joist, ground and the ceiling lines should be drawn. Then steps, porches, columns, windows and doors should be drawn in along with their measurements. Besides doors and windows, other additions, such as siding, should be made. It should be indicated whether it is brick or block. Rafter ends should be drawn in. Eave lines and soffits should be shown. Dormers and gable ventilators should be drawn in. The type of siding used on the building should be

ELEVATIONS FROM FLOOR PLAN



shown. The type of roof covering should be indicated, wooden, asphalt or composition. Special features such as brick flower boxes or wooden shutters should be indicated. The chimney should be drawn and dimensioned above the ridge line. Finally, all lines on the drawing should be dimensioned and labeled.

DRAWING SCHEDULES

Many parts, particularly some doors and windows, cannot be shown in detail on the drawing. Detailed information about doors and windows then is contained in what are called *schedules*. In schedules, each door or window is marked with a letter. Then the letter is marked in the left hand margin of the schedule form. Out to the right of the letter, a description of the door or window is written in and any features of the fixture are noted. The dimensions, the material, the type and the manufacturer all should be noted. Door and window schedules should indicate whether a screen will be used. With window schedules the number of panes in the glass and the type of glass used are noted.

PREPARING PLOT PLANS

Once an architectural draftsman has developed the skill to draw elevations, *plot plans* can be designed. Plot plans show the location of all buildings, sidewalks, garages, pools, trees, fences and other features on any given lot. The compass bearings of each of these features are drawn in. Contour lines for the plot are also sometimes drawn in. The length and width of each feature are carefully noted.

These are the steps to be taken in drawing a plot plan. First, the lot should be drawn. The name of the subdivision, the county and the State should be lettered. The adjacent street and alley should be drawn and their names lettered. Next, both true North and magnetic North should be indicated. The size of the lot and the magnetic bearings of each of its boundaries should be noted. Then the setback, the distance between the building and the curb should be shown. The distance from the curb to the back property line should also be noted. After this basic information is drawn in, the foundation should be shown. The distance from the edges of the foundation to the adjacent lot boundaries should be indicated. The finished floor elevation and corner grade should be shown. The garage should be outlined with its floor elevation. Finally the driveway, sidewalks, pools, trees and so on should be shown. The roof overhang, and places where ridges and valleys intersect should be indicated with hidden lines.

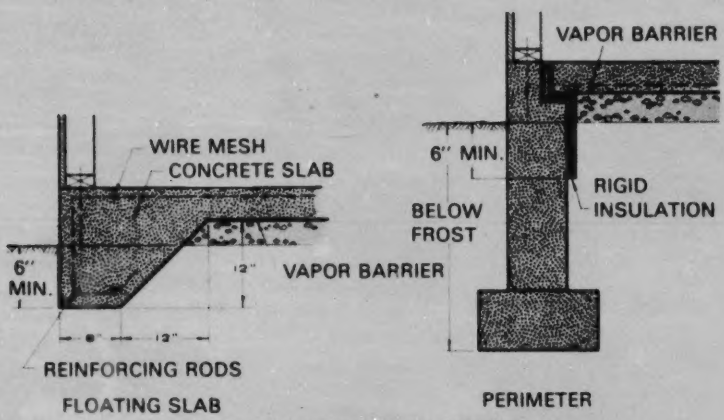
Two other features which are often drawn on plot plans are contour and utility lines. Contour lines should be shown where the elevation of the lot changes a great deal over a short space. When drawing contour lines, choose an interval. The contours should be drawn with dashed lines. The contour lines should show how water drains off the lot. Utility lines should also be shown. The location of water and gas mains, sewer lines and electric poles

and wires should be clearly indicated. The nearest fire hydrant should also be shown.

When a plot plan is drawn, it shows a view of the property from above and the relationship of each part to the other parts. Architectural draftsmen however, often make working drawings which show which parts of a building are to be constructed in sequence and how they will be fastened to other parts.

PREPARING FOUNDATION PLANS

Although foundation plans differ from one building to another, let's see how a small frame house foundation would be drawn. Several types of foundations are used in residential construction. Nonetheless, most foundations are built on a concrete slab. When drawing the slab, the draftsman should draw in the wall outline. The wall footing should be drawn with construction lines. Doors, windows and their footings should be noted. If fireplaces or staircases are to be placed in the house they should be shown. Any drops or rises in the slab should be noted. The boundaries of the water proof vapor barrier should be indicated. The minimum thickness of the slab should be marked.

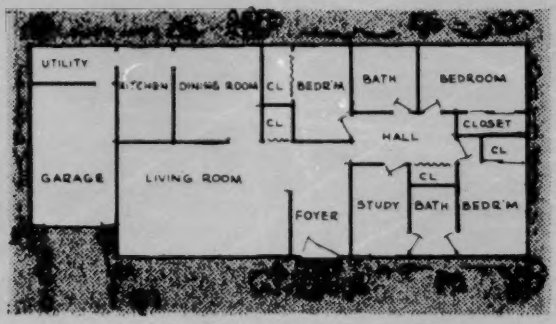


FOUNDATION WITHOUT BASEMENT

Besides the top view of the foundation, the draftsman should make foundation beam drawings. Beams should be spaced at most, 15 feet apart. Outside beams should be set at least 30 inches deep; interior beams should be set at least 24 inches deep. Beams should be at least 10 inches wide. The slab should be at least 4 inches thick and 8 inches above ground.

PREPARING FINISHED PLANS

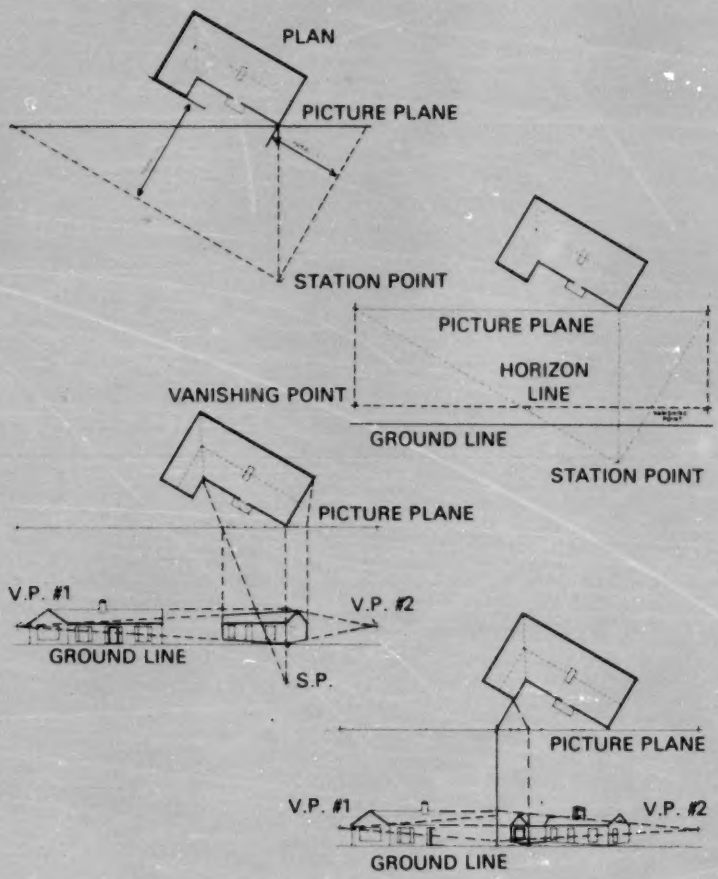
Architectural draftsmen are frequently asked to make drawings from quickly-done sketches. There are several steps used in passing from a rough design to a finished plan. The first step is to draw closed areas for the kinds of activities which will be accommodated in the house. Then these areas are divided into the appropriate rooms—kitchen, bedrooms, living room, bathroom and so on. These rooms should be thought of as pieces in a jigsaw puzzle. The draftsman should choose a fairly small scale such as 1/4 inch to 1 foot. In order to plan a house adequately, the designer should have some idea of the size of house furnishings, kitchen fixtures and bathroom fixtures. The outside wall of the house should be drawn lightly. Next, the partitions between rooms should be lightly penciled. Outside doors and windows should be marked. Closets and closet doors should be indicated. Plumbing fixtures and cabinets should be drawn. Electrical symbols should also be drawn at the right spots. Each room of the house should be labeled. Finally, the title block should be drawn and filled in.



PERSPECTIVE DRAWINGS

Architectural draftsmen should be able to make perspective drawings. A perspective drawing is very similar to an isometric or oblique drawing. It gives depth to a drawing, but it adds something else. When you look down a straight road or a railroad track, you see the sides of the road or the rails coming closer and closer together. At the horizon they look as though they meet. Similarly buildings seen from far away seem to be a great deal smaller than they are up close. Perspective is a way of drawing things so that objects further away are drawn smaller than objects up at the front of the picture. There are several different methods of indicating perspective used. One of the most commonly used by architectural draftsmen is called *two-point*

perspective. This method is one in which objects become smaller as they move toward two points—one on each side of the horizontal line of the drawing. There are certain steps to follow in making a two-point perspective drawing of anything. The first thing the draftsman does is to draw a horizontal line across the paper. The line drawn is called the *picture plane*. Then the draftsman makes an outline of the building. One corner of the building appears to be closest to the observer. A line perpendicular to the picture plane then is drawn. A line parallel to the building's front wall intersects the picture plane at one vanishing point. A line drawn parallel to the adjoining wall intersects the building plane. The point at which these three lines intersect is called the *station point*. The station point is the place a building



would appear to an observer as it appears in the drawing. After these lines are drawn, the ground line should be shown parallel to the station line. Six inches above the ground line the horizon line should be drawn. A vertical line from the point where the line parallel to the first side of the building intersects the picture plane should be drawn to the horizon line. This will locate the first vanishing point. Another vertical line should be drawn from the second parallel line to the horizon line. This will locate the second vanishing point. Then the elevation view should be drawn on the ground line. The draftsman should take a triangle and draw lines from the station point to door and window openings. Then lines should be drawn to the ground line from the points at which the lines between the station point and the plan crossed the picture plane. The building corner line will be the only line in the drawing drawn true to scale. Then lines should be drawn from the top and bottom of the corner to both the first and second vanishing points. These should include ridge, eave and door elevations. This will make a series of triangles. Then the building should be shown inside these triangles.

These are the main techniques architectural draftsmen use. Although many different types of drawings are made, they all rely on these basic techniques.

GLOSSARY
DRAFTING

Airbrush—a mechanical device that uses forced air mixed with a prepared liquid forced through a spray nozzle to produce certain desired effects on drawings.

Angle—the distance between 2 rays with a common point.

Blueline—a plan or drawing made on a special, sensitized paper creating the effect of blue lines on a white background.

Blueprint—a plan or drawing made on a special, sensitized paper creating the effect of white lines on a blue background.

Detail—drawings which are done on a larger scale than that of general drawings, and which show features which would not normally be seen on general drawings.

Dimension line—a light, thin line drawn from one point to another indicating a certain length between two given points.

Dividers—a compass-like drafting instrument used to transfer sizes, spacings, dimensions, etc.

Drafting machine—an instrument, mounted on the drafting table, comprised of a vertical bar capable of moving laterally; attached to it is a protractor head with two scales attached which may be moved vertically. The scales may be set at any angle; at 90° this arrangement substitutes for and is superior to the T-square and triangle combination in drawing horizontal and vertical lines.

Elevation—an orthographic view of an object altered in scale.

Floor plan—a drawing of a house showing the entire floor as it is to be constructed.

Ground line—in an orthographic view of a house, a line which represents the ground.

Guidelines—light, thin lines used as guides in lettering and drawing.

Hexagon—a polygon with six sides and six angles.

Horizon line—a line used in perspective drawing to indicate a vanishing distance, or the point where all lines tend to vanish.

Horizontal—operating in the same plans or parallel to the horizon line.

Isometric—a 30° angle view of an object that is drawn without bringing in perspective.

Legend—an explanation of symbols or notes that appear on a drawing or detail.

Lower case—the small letters of the alphabet (as opposed to the capital letters).

Octagon—an eight-sided geometric figure.

One-point perspective—a drawing which uses one point for a vanishing point.

Orthographic—a multiview drawing in two dimensions, showing flat views of the object.

Parallel—the condition which exists when two or more lines are adjacent and do not intersect at any given point and are equidistant at any two given points.

Perimeter—the measurement around the outside of an object.

Perpendicular—a line which intersects or meets another line thereby forming a right angle.

Perspective drawing—a drawing which appears to have actual depth because of the arrangement of its lines on a fixed vanishing point, thus showing the object as the eye sees it.

Plan—the top view of a working drawing which has been cut by an imaginary plane, exposing the interior as well as any adjacent objects.

Projection—1. The representation of an object on a plane. 2. The extension of one line from another.

Protractor—an instrument graduated in angular degrees.

Quadrangle—a flat plane having four angles and four sides.

Rapidograph—a drawing pen containing its own ink supply. They come in various sizes.

Rendering—to make a drawing more life-like by adding color or shading the drawing in; a life-like drawing or perspective shaded with pencil, ink, colors or airbrush.

Rough drawing—a drawing containing all the construction lines which were necessary to complete the drawing.

Ruling pen—an ink pen used in drafting.

Scale drawing—a drawing of an object made at a size other than the actual size of the object, although proportionally accurate.

Section—a drawing which has been cut so as to expose its interior.

Sepia—a brown-tone (or sometimes black) print usually made in blueprint machines.

Template—a pattern, usually which is made of transparent plastic, used as a guide in drawing various complex shapes.

Transcribe—to copy.

T-square—a drafting instrument which consists of a ruler usually 2 to 3 inches in width and from 1 to 5 feet in length, with a crosspiece attached to one end of the ruler or blade.

Two-point perspective—a drawing which has two vanishing points.

Upper case—pertaining to capital letters as opposed to lower case letters.

Vertical—a line which is exactly upright or perpendicular to a flat plane.

Working drawing—a drawing which contains all of the necessary information needed for the construction of an object.

APPENDIX
DRAFTING

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1126 16th Street, N.W.
Washington, D.C. 20036

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P. O. Box 2955
Tulsa, Oklahoma 74101

American Society of Professional Draftsmen and Artists
731-B Martin Drive
Baltimore, Maryland 21221

Association of Structural Draftsmen of America
17023 West Ten Mile Road
Southfield, Michigan 48075

ESTIMATING

INTRODUCTION

Estimating is the process of determining the probable cost of a construction project before the construction is begun. The primary objective of estimating is to enable a business to make the maximum profit possible within competitive bidding.

Estimates are used for many purposes. The estimate may serve as a basis for competitive bidding or it may only be used as a guide for ordering materials. In addition, estimating is essential for purchasers, mortgage lenders and the insurers' of a building who seek to limit their responsibility to the cost of a comparable replacement.

To estimate means to approximate. It should be understood at the outset that estimating is not an exact science. In actual practice, the spread between contractors' bids on new construction ranges from 10 to 30 per cent or more. Nevertheless, estimating calls for the highest possible degree of accuracy in its preparation. The careful listing of items, the proper measurements, the consideration of labor requirements, the identification of materials as to size, kind and quality, and the double checking of all arithmetic are of utmost importance.

A general knowledge of materials and methods of construction is absolutely essential to cost estimation. There is a direct relationship between the knowledge a person has of building construction and the likelihood of becoming a highly competent estimator. It is not necessary for an estimator to have experience as a journeyman. In fact, many estimators have had little or no practical experience as mechanics in a building trade. They do, however, have a broad knowledge of building construction and materials which they have learned from observation and study. They are good detail people and are able to visualize every operation which is necessary to complete the work.

Since there is considerable variation in construction methods from area to area (and even from year to year within areas), it is essential that an estimator be familiar with local practice. A change in a construction technique can make a considerable difference in the materials or labor required for a particular job. Only by constant study and observation is it possible to keep abreast of current construction procedures and methods.

An estimator can never really know enough about construction materials, especially considering the overwhelming range of new products which are now available. For an estimator to be fully informed on available materials and their usage, it is necessary to

take advantage of every available source of information. This means studying trade publications, as well as talking to manufacturer's representatives, wholesalers and jobbers.

An estimator must be able to read blueprints and plans easily and accurately. This skill is not particularly difficult to develop, but it does require study and practice. The symbols and methods of indicating architectural details can be found in a number of texts. A few hours spent learning the symbols can be of considerable value to a future estimator.

A very important quality of a good estimator is the ability for attention to details. There are some 30,000 individual materials, parts and hardware that go into the average house. Many of these items are incorporated into component parts today, but even then the estimator must be prepared to analyze the house item-by-item to "cost" alternative methods of construction. The omission of items that will be needed to construct the house is often more serious than a miscalculation in the quantities of the item needed. Leaving things out may secure the bid, but may also put the estimator's firm on the road to bankruptcy.

It is also important for an estimator to handle simple arithmetic with confidence. Although it is seldom necessary to do any mathematics more involved than simple addition, subtraction, multiplication and division, a slight error can be extremely costly.

A good estimator follows a systematic approach, so it is wise to learn a good method of estimating and do each new estimate in the same pattern. Consistency in doing each estimate by the same method will result in a great deal of practice and will eventually lead to greater accuracy and efficiency.

Finally, one of the most important assets an estimator can have is a sense of "reasonableness." Besides routinely checking all arithmetic, it is important to apply a "reasonableness" check at

every stage of the estimating procedure. If an estimate fails to be consistent with common sense, there is usually something wrong—regardless of the references and calculations, however elaborate, that have been used.

MATERIALS AND SUPPLIES FOR ESTIMATING

The estimator needs a satisfactory place in which to work. Adequate space in which to spread out plans, specifications and work sheets is required. Good light is essential, and access to references on materials and prices (such as suppliers' catalogs) is important. A telephone is also needed to secure prices and other information.

Check Lists

A detailed check list is considered a must by most estimators. Even the most experienced estimator realizes the chance of not omitting items by using such a list. The more detailed the check list the better it will serve its purpose, and, as new materials become available, they should be added to the list to keep it current. Although many things on the check list will not be found in every estimate that is prepared, it should always be checked carefully to prevent omissions.

In general, it is a good idea for a check list to follow the logical process of construction. In this way, if the bid is secured, the estimate can be used as a guide for the builder in ordering materials. It can be used by the supplier in sending out the materials needed to complete each phase of construction.

A variety of *estimating work sheets* are available and are in widespread use. Primarily, an estimating sheet is a work sheet. It should have adequate space for any calculations or comments the estimator wants to put on it. It should also have room for quantities of material, and a place for the extension or the quantity multiplied by the unit price.

Architect's Scale

The architect's scale is standard equipment for an estimator. For desk work or at a drawing board, a large full-size twelve inch triangular scale is usually preferred. There are many times, however, when it is useful to have a small six or eight inch pocket scale available.

Use Of Plans

One of the first items needed to do a good job of estimating is a complete set of plans, commonly referred to as prints, blueprints

or working drawings. These plans should be complete enough to enable the estimator to visualize the building, not only in its completed form, but in all of its components.

A complete set of plans will include plan views, elevations, sections and details. Although the estimator rarely has any influence over the adequacy of the plans received, it cannot be expected that the estimator can turn out an accurate estimate if it is impossible to determine what the designer has in mind.

Plan views generally include a plot plan, a foundation plan and a floor plan for each floor, at the very minimum. A plot plan is essential to determine the amount of sidewalks, driveways, incinerators or other items included in the estimate. The foundation plan will indicate the location of the required footings. This includes the basement partitions and stairways, as well as piers and posts supporting the superstructure. Excavated and unexcavated areas will normally be determined from the foundation plan. The first floor plan will show the size of the floor area as well as location and quantity of interior partitions. In the event the structure is multi-story, a plan view should be included for each floor. A roof framing plan is useful, especially if the plan has numerous corners and setbacks. Usually, in a simple structure, the location of hips and ridges would be indicated on the plot plan.

Written Specifications

An estimator should have a complete set of written specifications covering all the various portions of the structure to be estimated. The specifications are a written description of materials and material grades to be used in the structure. These sometimes include quantities.

METHODS OF ESTIMATING

There are a number of cost estimating methods presently in use by suppliers, builders, appraisers, mortgage lenders and others. Individual estimators must carefully evaluate the purpose of each cost estimate before determining the type of estimating system to use. The considerations involved in making such a decision include 1.) the degree of accuracy required, 2.) the degree of flexibility required, 3.) the degree of detail required and 4.) the degree of difficulty involved in preparing the estimate.

Comparative Square Foot Method

The "comparative square foot or cubic foot method" is most commonly used to quickly arrive at rough cost estimates. Using this method, the number of square or cubic feet contained within a "comparable," recently completed structure is divided into the

total cost of the structure to arrive at the applicable unit cost per square or cubic foot. The resultant cost per foot is then applied to the structure in question to get an estimated total cost. There are a number of refinements to this basic procedure which can give more accurate results, but, in the final analysis, accuracy is rarely attainable because no two buildings are exactly alike in method and quality of construction.

Differential Method

Differential comparative systems attempt to minimize errors by applying differentials for differences between the standard, or base structure and the structure in question. When used by an experienced estimator who has access to good and extensive data on the costs of differentials, and by a person who can readily recognize when such differentials exist, this method can yield fairly accurate results. This method can only give an overall cost estimate, however, and it is not usually accurate enough for bidding purposes. It does not produce sufficient detail to furnish information for purchasing or for cost control concurrent with construction.

Quantity Survey Method

The quantity survey method is a detailed estimate of the required dollar outlay for materials, labor, equipment, overhead and profit to complete a given structure. Every unit of material is listed and extended by quantity and price to give a total materials cost. To this is added the cost of labor and equipment to do the required work and to place the material in the structure. In some instances,

bids submitted by subcontractors may substitute for detailed material and labor estimates. Fees of needed consultants, such as attorneys and architects, are added as well as fees for necessary financing. Finally, overhead costs and the profit of the building contractor are added to give a summation of all costs. This estimating method, if used with care, yields accurate results. It produces material lists for supplying or purchasing purposes as well as information useful in financing, scheduling and cost control.

For certain people in the building industry, the use of the quantity control method is unavoidable. Suppliers must make up accurate materials lists and contractors and builders must have accurate cost estimates if they are to remain in business. Financial institutions, too, are finding that they must have people capable of doing, or at least of checking estimates of builders. Insurance companies may have to prepare or check estimates of the cost of replacing buildings.

In addition to accuracy, this method provides sufficient detail for nearly every purpose. It further provides the flexibility necessary to meet changing requirements. The cost and time to do an accurate job always will remain relatively high, but objections can be minimized by a properly trained estimator who uses a systematic and orderly approach.

The unit-in-place method of cost estimating is simpler in application and less time consuming once "units" are calculated. It can yield very accurate results. Using this method, the estimator spends a great deal of time in calculating the cost of structural units installed as incurred by the contractor and various subcontractors. The unit cost includes both materials and labor at the rate for the locality. For example, the estimator will determine the cost of placing a cubic yard of concrete in a foundation; applying a square foot of flooring or sheathing; of building a linear foot of partition of a particular type. Once these costs are carefully prepared and checked, the estimator can then apply unit costs to arrive at a total cost figure. Such a method, obviously, is of value only when a considerable quantity of estimating must be done on similar types of structures. It is of particular value to volume builders and remodelers when the costs of putting the system together can be recovered through repeated usage.

DETAILED ESTIMATING

In order to estimate the total cost of a construction project, estimates need to be made of individual parts. The cost of concrete on a project is estimated differently from the cost of a paint job. Both of these estimates are done differently from an

estimate for electrical wiring or plumbing in the building. Each type of construction work and material, therefore, has its own special estimating procedure. In fact, there are estimators who specialize in the costs of only one type of construction work in a building. There are electrical, plumbing, painting, plastering and concrete estimators, as well as others. Let's look at some different procedures used by estimators.

Estimating A Concrete Sidewalk

As a first example, let's review how the costs of labor and materials in a concrete sidewalk would be estimated. The first step is to determine the amount of ground material which will have to be dug and removed. The amount of material dug up is measured in cubic yards (each cubic yard has 27 cubic feet). To find the number of cubic yards in any number of cubic feet, multiply the number of cubic feet by .037 or divide it by 27. When estimating excavation costs, the kind of material being removed is considered. Topsoil, for instance, is easier to remove than bedrock. Another consideration is the way it is removed. Costs of hand shoveling are different from the cost of trenching machines. Trenching machines have different costs than blasting. Even with hand shoveling, some ground is easier to dig than other ground. Sometimes picks must be used to loosen the ground. Then, too, the way the excavated material will be removed from the worksite affects costs. Will it, for instance, be taken by wheelbarrow a short distance to another part of the site? Will it be loaded into dump trucks and hauled away? Is the ground wet or dry? All of these things must be considered.

Next, the estimator must be able to calculate the volume of earth to be excavated. Excavations are usually dug so that a rectangular, prism-shaped empty space is left. The volume of a rectangular prism may be calculated by the formula $V = l \times w \times h$. V = volume of the prism, l = length of the prism, w = width of the prism, h = height of the prism. For example, in calculating the volume of dirt excavated from a sidewalk 25 feet long, 3 feet wide and 1-1/2 feet deep, the volume would be equal to 25 x 3 x 1-1/2 feet. This would be 112-1/2 cubic feet. Since excavations are usually measured in cubic yards, the estimator would multiply 112.5 cubic feet by .037. The number would be 4.1625 cubic yards of material to be excavated for the sidewalk.

Once the excavation costs have been calculated, the next step is to calculate the cost of a sandbed and forms for the concrete work. Three pieces of information are required to calculate the cost of sand fill: The amount of sand fill needed, the cost of sand (which can be found by multiplying the cost per unit by the amount needed; sand volume is measured in cubic feet or cubic

yards), and the cost of labor to spread and tamp the sand (which is found by multiplying the number of hours of labor needed by the cost per hour of the labor). Besides the cost of a sandbed, the cost of wooden forms and reinforcing steel will need to be estimated. When the cost of the forms is determined, the total area of the sides of the walk is considered. The area of each side of the sidewalk may be found by multiplying its length by its height. Once the total area to be supported by forms is calculated, the amount of lumber can be calculated. This amount needs to be multiplied by the cost of lumber per square foot. The number of nails needed should be determined, and that number should be multiplied by the cost per pound to find the cost. The labor cost needed to assemble the forms should be calculated. Labor costs can be figured by multiplying the number of hours required to assemble and disassemble the forms by the cost of labor per hour. The labor cost and the material cost are then added together to arrive at the cost of forms.

Estimating Steel Reinforcing Rod

A material used in concrete work is steel reinforcing rod. To estimate its cost the number of bars of each size and length to be used is listed. Then the total number of feet (in linear feet) of each type of bar is calculated. The number of feet of reinforcing bar in each size is multiplied by the weight per foot of each size to find the total weight. Then the weight of the reinforcing bars is multiplied by the cost per pound of the bars. This gives the material cost. The next step is to calculate the labor cost. This is found by estimating the number of hours required to unload and store the bar, then multiplying the number of hours to do the job by the cost of labor per hour. Next, the cost of labor to place and tie the bars should be figured. Finally, the cost of materials and the cost of labor should be added together to find the total cost of reinforcing bar.

Estimating Finishing A Sidewalk

The next calculation to make is the cost of finishing the walk. The estimator first calculates the area of the surface to be finished. This area is the top surface of the walk. Its area may be calculated simply by multiplying the length of the walk by the width. If the concrete is to be colored, the estimator should calculate the amount of dye needed. Then three different labor processes need to be determined. The first is the amount of labor needed to block the sidewalk into squares. Next, the number of hours needed to screed and vibrate the concrete is figured. Finally, the number of hours needed to trowel the concrete is calculated. The cost per hour of each different type of labor should be multiplied by the

number of hours of labor required. The three cost figures should be added together to find the total cost of the finishing.

Estimating Profit And Overhead

Once the estimator has figured the cost of the concrete work, the profit and overhead costs of installing a concrete walk should be estimated. To do this, first is calculated the annual cost of operating the contracting business. The percentage of a year which will be taken up by this particular job is figured. This percentage is multiplied by the total yearly overhead. The results are then added to the project cost. For instance, suppose the estimator figures that a project will take 1-1/2 days to do. Then he or she will figure what percentage of the year 1-1/2 days is. Suppose that it is .2% of a working year. The estimator would multiply .2% by the total cost of running the business. If the total cost were $20,000, the estimator would multiply .2% by $20,000. The result would be $40. The estimator then would add $40 to the construction costs. Then the total cost of the project is multiplied by the usual percentage of profit to find the amount of profit to be added on. The amount of profit then is added to the cost to give the total amount to be charged.

Once the costs for the different parts of a project have been figured, the estimator tabulates these different costs as well as the total project cost on what is called a *summary and recapitulation sheet*.

ESTIMATING OTHER CONSTRUCTION WORK

Let's see how estimating is done on other types of construction work, such as masonry work. As a practice example let's consider a brick veneer residential building. The first step with brick, as with wood siding, is to calculate the area to be covered. (A brick veneer wall means brickwork 4 inches thick.) The length and the width of the wall should be multiplied together to find the number of square feet. The number of square feet in each wall then, should be added together to find the number of square feet in the house. Next, the estimator calculates the number of bricks needed. If mortar joints 1/4 inch thick are used, there are 7 bricks per square foot. If thicker mortar joints are used, estimating 7 bricks per square foot allows for wastage. The areas of doors and window openings are added and subtracted from the total area. The remainder should be multiplied by 7 to get the needed number of bricks.

Once the number of bricks has been determined, the amount of mortar needed should be figured. Then the cost of bricks should be calculated. This can be found by multiplying the unit cost of

brick by the number of bricks needed. Then the cost of mortar should be figured. This will be the cost of mortar per cubic foot multiplied by the number of cubic feet of mortar needed. These two figures, when added together, will give the materials cost. The labor cost should then be estimated. On the average, it takes one mason 6 hours (with a mason's helper working 3 hours) to lay 100 square feet of brick. These figures should be multiplied by the cost of the mason's labor per hour to find the labor cost. Finally, materials cost and labor cost should be added together.

Air Conditioning And Heating

Air conditioning and heating needs to be estimated on most buildings, because central heating and cooling systems are usually installed while the building is being constructed. The estimator usually must include the cost of this in general estimates. The first thing is to calculate the volume to be heated or cooled (the total number of cubic feet in a building). Most rooms in buildings are cubes or rectangular prisms. The volume of either of these is found by multiplying the length by the width by the height of the room. The volume of each room is calculated and added to find the total volume. Tables exist which show the size of the heating and cooling unit which will be needed. There are three basic parts to the cost: The cost of the heating/cooling unit and the labor needed to install it; the duct of the ductwork and its labor; the cost of grilles, heat registers, etc., and the cost of labor for them. Finally, the cost of insulating ducts and electrical work should be calculated.

REMODELING ESTIMATES

Remodeling estimates are slightly different from other building estimates. Let's look at some of the parts of a remodeling job. Sometimes masonry is patched. To figure the cost of patching masonry the estimator first calculates the area to be patched. Masons can hand chip about 200 bricks per day. The mortar used to repair it and new bricks needed should be calculated as in new masonry.

Caulking and weatherstripping are often part of a remodeling project. Doors and windows can be caulked with oakum at a rate of 340 to 400 feet in each 8 hours. One gallon of caulking material will caulk about 150 linear feet. Weatherstripping for doors will take anywhere from 1 to 2-1/2 hours to apply. The amount of weatherstripping required may be estimated by measuring the number of linear feet around the outside of doors and windows.

Another figure often found in calculating remodeling costs is the cost of reglazing windows. Glass is priced per square foot. The labor for each window will vary. Glaziers can do twenty 40 x 48

inch windows per 8 hour day, or sixty five 12 x 14 inch windows. About four glazing points will be needed for each pane.

Roof repairs are figured as new roofing would be calculated. The only extra to figure is the cost of removing the old roofing material. A built-up roof can be stripped by a roofer and helper in about 1/2 hour for each 100 square feet. A shingle roof can be stripped by a roofer and helper at a rate of about 2,000 square feet per day. It takes about 2 hours per 100 square feet to install asphalt strip shingles.

Window and door screens are often replaced on remodeling projects. A window screen can be replaced in about 1 hour, 20 minutes. The cost of screen itself may be calculated by remembering that it is sold by the square foot, and this cost is multiplied by the area.

On a replastering project the major calculation which is different from the figures for a new plastering project is the cost of stripping old plaster from the walls and ceilings. A laborer can strip 60 to 70 square feet of wall per hour and 30 to 50 square feet per hour from ceilings.

Wood trim costs are different on remodeling projects because of the cost of removing old trim. Old trim can usually be removed at a rate of about 100 feet per hour. Wood floors can be sanded at a rate of 300 to 1,000 square feet in each 8 hours. Old floor boards can be removed at a rate of 100 square feet per hour.

Painting costs will differ if old paint must be removed. Old paint may be burned off at a rate of 30 to 40 square feet per hour.

Plumbing fixtures take about the same amount of time and cost to replace as to install new ones. Electrical wiring is similar.

The costs of remodeling should be tabulated and added up. The percentage of overhead costs should be added in, and the required profit margin calculated. Then the estimate is finished.

APPENDIX
ESTIMATING

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EXPEDITING

INTRODUCTION

An expediter is a person who determines and maintains construction schedules; orders materials and decides when they should be delivered to the job site and in what order; is responsible for obtaining construction permits and clearances; maintains reports, fulfills inspection requirements, signs purchase orders, sets delivery dates, priorities and allocations. The expediter serves as a liaison between the owner, the construction workers and the suppliers. The expediter works with the architect, engineers and construction workers to decide what materials should be purchased and when they should be ordered. An expediter obviously must have some knowledge of construction methods and materials; the ability to read blueprints and specifications; the ability to use such tools of systems engineering as critical path analysis to determine the most efficient way to schedule people and deliveries of materials to a job site. This means that an expediter should at least be a high school graduate with construction experience and a capacity for mathematics.

JOB PLANNING AND SCHEDULING

The most important part of the expediter's job is the planning and scheduling which takes place before the job actually begins. Without a careful, step-by-step analysis of the job to be done, it is unlikely that any construction project could profitably succeed. It is the expediter's job to analyze the project to determine the most efficient, least expensive way (in both time and money) to schedule the work. The expediter's tools are the intricate methods of cost analysis which have been developed since World War II. These are the *Critical Path Method*, (CPM), and the *Program Evaluation and Review Technique*, (PERT). In order to apply these techniques, the expediter must be adept at reading blueprints and building plans, must have a general knowledge of building laws and building codes, and be capable of reading and understanding contracts and building specifications.

The expediter must first read the contract and specifications carefully to know exactly what is to be done and the types of equipment and labor needed to do the job. The work involved must be analyzed to determine the most efficient sequence of work and to determine which tasks can be performed simultaneously.

CRITICAL PATH ANALYSIS (CPM)

The major tool which the expediter uses is critical path analysis, a tool of systems engineering. The expediter first prepares a list of

the activities of the project and the order in which they occur. The expediter then refers to the cost estimates to arrive at the approximate construction time involved in each step. The next step is to draw up a "critical path analysis network," which is a diagram showing the sequence and interrelationship of activities on the job. The expediter numbers the events on this network and, after analyzing the information, notes the earliest starting time (EST) and the earliest finishing time (EFT) for each activity. The most efficient sequence of operations, or the "critical path" for the job is then determined. After preparing the critical path, the expediter develops schedules for the construction personnel and the delivery of materials to the site.

It is also the expediter's responsibility to obtain necessary licenses and building permits, to place orders for the materials and to arrange for labor with various subcontractors. If the expediter does this job efficiently, the employer can be saved a great deal of money; if done badly, the results could be financially disastrous.

CHECKING PROGRESS AT THE JOB SITE

Once the job is actually underway, the expediter spends considerable time at the job site checking the progress of the job and making sure the project is proceeding according to schedule. If changes must be made in the job, or if the job fails to proceed according to schedule, the expediter then confers with the contractor, the architect or the owner to revise schedules and plans.

In many ways the expediting function can be found in every phase of construction. A masonry subcontractor will perform or have someone else perform the expediting function. An electrical

subcontractor will do the same. In fact, the systematic, organizational job of expediting is usually performed in different degrees by many individuals at the same construction site.

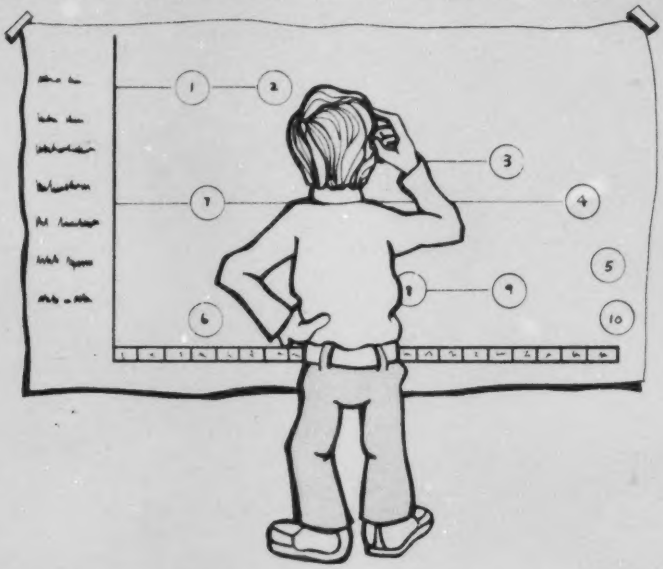
BACKGROUND OF EXPEDITERS

Generally, expediters enter their field in one of two ways: Some were previously supervisors with considerable experience and a "feel" for construction; others are individuals with college degrees in engineering and experience in construction.

It would be very unusual to find a job specifically in expediting upon leaving high school. Most likely, your career in construction, at whatever job you may be working, will require some knowledge of the expediting function. With additional experience and training it may be possible for you to eventually become a project expediter.

PROGRAM EVALUATION AND REVIEW TECHNIQUE (PERT)

In order to better understand how an expediter works, it might be useful to prepare a PERT chart. A PERT chart or a critical path method (CPM) chart, among other things, shows the sequence of events in a construction project. It also shows the estimated length of time which will be needed to finish any given part of the project. A CPM chart is drawn to show the most efficient way to



schedule a project. When the chart is drawn the expediter may see that it is possible to schedule two activities simultaneously and cut down on the total time spent on the project.

First, let us look at a CPM chart. When a CPM diagram is drawn, it has three main purposes: First, it shows the time the project will be completed; next, it shows which activities determine the completion time, that is, which activities must be done in an exact sequence from beginning to end; last, the chart shows the amount of time for tasks which are not on the main sequence.

The expediter, before drawing a CPM chart, lists all the tasks which must be performed on the project. Then the list must be placed in the exact order in which the tasks will be done. Once the list is arranged in order, the chart is ready to be drawn. Each construction task is shown by an arrow: The tail of the arrow shows the beginning of the task; the head of the arrow shows the end of the task. Each arrow head points toward a *node*, a completed stage of the project. The tasks are arranged in order of three questions which the expediter asks about each activity. These questions are:

1) What tasks must be finished before this task can begin?

2) What tasks must be begun after this task is finished?

3) What tasks may be done at the same time as this task?

Two tasks should not have the same beginning and ending points. When two tasks do have the same starting and finish points they should be drawn with two different finish nodes connected by a dashed line. Once the chart is drawn, the length of time each activity will last is written at the center of the arrow. Then the earliest event time (called EET) of each node is calculated. This is the earliest time that a given event can be completed. The earliest starting time (called EST) of a task is the total EET of the tasks which led up to it.

Some tasks on the project will not require all the time available for them. This extra time is called free float or FF. Tasks for which there is no free float are on the critical path; they are necessary parts of the construction sequence.

EXPEDITING MATERIALS TO JOB SITE

Once the expediter has set up the sequence of events to occur in the project, the job must be arranged to have the necessary construction materials delivered at the right time. This is an extremely important task. If an estimator has, say, roofing shingles delivered at the time framing lumber is needed, a great deal of time is wasted, and the shingles may be damaged by the

delay. If, on the other hand, roofers are waiting on the project and being paid while the framing carpenters are still working, more time and money are wasted. The expediter's job is to make sure the framing carpenters have their framing lumber and that the roofers arrive on the job after the framers finish, but at the same time as the shingles.

SURVEYING

INTRODUCTION

Surveyors play an important part in the construction of highways, airfields, bridges, dams, pipelines and other structures by providing information on measurements and physical characteristics of construction sites. They also locate land boundaries, assist in setting land valuations and collect information for maps, charts and plates.

The primary task of the surveyor is to determine the precise measurements and locations of elevations, points, lines and contours on or near the earth's surface, and the distance between points. The surveyor/supervisor is directly responsible for the survey and its accuracy. The surveyor plans the fieldwork, selects survey reference points and determines the precise location of natural and man-made features of the survey region. This person records information disclosed by the survey; makes mathematical calculations based on such information; verifies the accuracy of survey data; prepares sketches, maps and reports.

In making detailed measurements in the field, the surveyor is assisted by directed workers in a field party. A typical field party is made up of three to six members, in addition to the surveyor (sometimes called the supervisor or party chief). Included in the typical field party are instrument people who set up, adjust and operate surveying instruments, (including the theodolite, transit, level, laser level, altimeter and electronic measuring devices) at the points designated by the surveyor; chainpeople, who measure distances between points, using a metal tape or electronic distance measurement device (EDM); and rodholders, who use a level rod, stadia board or plumb bob and range pole to assist in measuring between selected points, elevations, distance and directions.

SURVEYOR SPECIALIZATION

Surveyors often specialize in one particular type of survey. Those doing highway surveys are concerned with establishing the points, grades and lines needed for highway locations. Those performing land surveys locate boundaries of a particular tract of land, prepare maps, record plat of the land, calculate areas and prepare legal descriptions of it for deeds, leases and other documents. Surveyors doing topographic surveys determine the elevations, depressions and contours of an area, and indicate the location of distinguishing surface features such as farms, buildings, forests, hedges, roads and rivers.

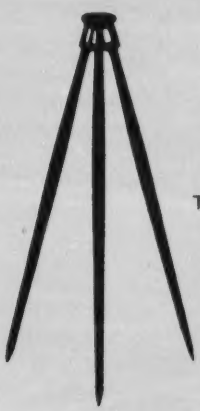
RELATED OCCUPATIONS

Several closely related occupations are geodesy and photogrammetry. Geodesists measure immense areas of land, sea or space, taking into account the earth's curvature and its geophysical characteristics. Photogrammetrists apply analytical processes and mathematical techniques to photographs and imagery obtained by aerial or ground surveys to make topographic maps, and measure and interpret the natural and man-made features of an area.

TOOLS USED BY SURVEYORS

The basic tools or instruments surveyors use are transits, leveling rods, measuring tapes and wooden stakes. Although surveyors make many different types of surveys, the steps they take are similar from one survey to the next.

The first thing a surveyor may do is [illegible] transit over a given point and to turn an angle. First, the *tripod* is extended, a



TRIPOD

three-legged stand which has threads in its top. The transit is screwed into these threads. Each leg of the tripod can be adjusted separately so that the transit can be made level even on very uneven ground. Once the transit is set up, a *plumb bob* is attached to a hook on the underside of the instrument. The plumb bob is a pointed metal weight which hangs directly over the point from which measurements are taken, if the instrument is properly adjusted. The legs of the tripod should be adjusted, and the transit itself should be moved until the plumb bob point hangs directly over the center of the bench mark, or point from which measurements are to be taken.

Once the transit is set up and centered, it is leveled. Before it is leveled, the surveyor needs to know the parts of the transit. A *transit* has three main parts. These parts are the upper plate, the lower plate and the leveling head. The *upper plate* is a flat metal plate on which a large compass and two leveling vials are mounted. Two upright arms support the cross-arms of the telescope. The cross-arms are attached to two wheels, one on either side. The wheels are mounted on bearings which allow the telescope to turn up and down. Beneath the plate is a vertical spindle upon which the telescope can be turned in a circle horizontally. The *lower plate* is exactly covered by the upper plate. It is a flat plate marked off in degrees, minutes and seconds. A screw, called the *limb clamp screw*, fastens the upper and lower plates together. There are two openings in the upper plate where the *verniers* meet the graduated circle. The lower plate has a hollow outer spindle which holds the inner spindle. The *leveling head* is made up of the bottom horizontal plate and a socket which holds the outer spindle in place. Four leveling screws are attached to the leveling head. On the underside of the leveling head there is a collar threaded so that it screws onto the tripod. A plum met chain with a hook is suspended from beneath the leveling head. The plumb bob string then is attached to the plum met chain.

In order to use a transit to measure angles, the surveyor needs to understand *vernier measurement*, because this is the way transits measure angles. A vernier scale is an added scale which allows

exact measurements between points on another scale. A vernier scale is a scale which is lined up next to a main scale. The difference between the vernier scale and the main scale is that the vernier scale has (n) divisions where the main scale has (n - 1) divisions. For instance, if the main scale has 12 divisions, the vernier would have 12 divisions for each 11 divisions of the main scale. The number of the main scale which coincides with a vernier scale line is the fractional part which is added onto the main scale measurement. That is, if the main scale reading is 3.0 plus some fraction, then that fraction will be equal to the main scale number marking exactly touching a vernier scale marking. If, say, the vernier scale marking meets the main scale marking at 8,

then the correct reading is 3.08. The smallest possible reading on a vernier is called the *least count*. There is a formula for finding the least count. It is:

$$\text{least count} = \frac{\text{smallest unit on main scale}}{\text{number of divisions on the vernier}}$$

When reading a vernier, the surveyor should stand right behind the vernier or right over it. The scale markings are checked to be sure they both fall outside or both fall inside of the vernier scale.

SETTING UP A TRANSIT

Let's look at how the transit is set up. Transits are removed from their cases by grasping the leveling head or the underside of the bottom plate. The transit should never be picked up by its telescope. It should then be screwed on to the tripod. The plumb bob should be tied to the hook on the plummet chain with a slip knot so that it will not slip.

The wing nuts on the legs of the tripod should be tight enough that they will slowly fall from their own weight when stretched out horizontally. The legs of the tripod should be spread far enough apart and pressed into the ground so that it is steady. The dust cap should be taken off the end of the telescope and replaced with the sunshade.

After it is set up, the transit should be exactly centered over a point. The surveyor should begin by standing about 2 feet down from the point and facing it. One leg should then be placed about 2 feet behind the point. The two other legs should be pulled outward until the head is nearly level. If the transit is still not level, the legs should be adjusted until it appears to be level on all sides. The plumb bob should be attached to the plummet chain and should hang within two or three inches of the point. The leg which is opposite to the plumb bob should be pushed back until the plumb bob is opposite the second leg. The second leg is pushed outward until the bob is 1/4 inch away from the point.

Now, the instrument can be leveled. On the leveling head, any two adjacent leveling screws may be loosened. Then the top plate should be turned until one of the level vials in the upper plate lies between two opposite leveling screws. The screws should be turned in opposite directions until the bubble centers. "The bubble will follow the left thumb," is a surveyors' saying. Then the head should be pushed until the plumb bob is exactly over the point. It should be exact, because transits measure very precisely. Any error will show up quickly. Both levels should again be adjusted using both pairs of opposite screws. When the levels have been centered, the transit should be turned 180° and

centered again. The transit is now set up and ready to measure angles.

MEASURING ANGLES WITH THE TRANSIT

It is not particularly difficult to measure a horizontal angle with a transit. A horizontal angle would be, say, the angle between two intersecting boundaries of a piece of land. There are three parts of the level used in measuring angles—the upper clamp, the lower clamp and the tangent screws. Let's see how these parts are used. If a surveyor would want to measure the angle between two intersecting lines on an open field this procedure would be followed. The instrument should be placed at point B and sighted in on the line. The transit should be leveled. The plates should be adjusted to zero. The upper plate should be held and the lower plate should be turned on its underside. Finally, when the plates are zeroed, the upper clamp should be tightened. The surveyor turns the upper tangent screw with a clockwise motion. Then the surveyor sights along one of the lines of the angle. The vertical crosshair in the telescope should center on A. The surveyor moves the telescope by *turning the base* with both hands. Then the lower clamp should be tightened up. The crosshair should be set on the object at A with the lower tangent screw. Now the surveyor reads the compass bearing for BA. Then the surveyor loosens the upper clamp and turns the plate until the vertical hair is on point C. Then the upper clamp should be tightened. The vertical crosshair should be placed exactly on point C. The upper clamp should be tightened. The zero reading still points toward A. The surveyor then reads the angle turned with the vernier. Then the compass bearing for BC is read. The measured angle and the angle measured from the compass bearings is compared. Surveyors always turn the transit in a clockwise direction to measure angles.

Once more let us look at verniers. This time let's examine transit verniers. Usually the outer edge of the lower plate of the transit is marked off in degrees and half degrees. Verniers are used so that angles may be measured to one minute (1/2 degree = 30 minutes). That is, the least count of the vernier is one minute. This means that 30 divisions on the vernier will cover exactly 29 divisions on the main scale. On transits, "double verniers" are normally used. Double verniers have divisions which can be measured both ways from a zero point. Angles which are measured clockwise are read off on the vernier from right to left. The surveyor starts at the zero point and looks left until a mark is spotted on the vernier which corresponds to a mark on the main scale. Angles which have been measured counterclockwise are read off on the vernier from left to right. The surveyor starts at the

zero point in the center of the vernier and moves left until a mark is spotted on the vernier which corresponds to a mark on the main scale.

After measuring off several angles with a transit, the surveyor has learned one of the main tasks. Everything else will build on this knowledge.

MEASURING DISTANCES

Another task surveyors do is to measure distances with a metal tape. In addition to measuring, the surveyor must make sure that the measurements are made along a straight line and that the line runs at an exact angle to another given line. Further, the path of the line must be marked with some kind of recognizable landmarks. *Chaining pins,* which are thin steel pins about 1/4 to 3/8 inch in diameter, are stuck into the ground to mark off exact distances. They become objects to be sighted in the transit, which are then placed exactly on the line. Later, wooden stakes are driven into the ground exactly where the chaining pins were located. Tacks are driven into the top of the stake to mark the exact location of the pins.

The first step in measuring a distance is to set up the transit exactly over the benchmark, the stake or other object which marks off a distance along a survey line. Once the transit is in place, the surveyor's tape is unrolled. This is a 100-foot long thin flexible steel tape marked off in one-hundredths of a foot. The tape is unrolled and held by two people. The person carrying the front end of the tape walks forward carrying chaining pins. The person at the rear supports the chain from behind and holds the end of the chain on the exact point from which measurements are being made. The chain is pulled taut by the headperson. Sometimes this person will raise the tape so that it will be above obstacles in the path. When this happens, the rear tapeperson must raise the tape the same amount so that the tape will be kept even. To keep the rear end of the tape over the point and to mark the exact point where the front end of the tape is, plumb bobs will be held to the 0 and 100' points of the tape; the points of the bobs will touch these points. Then the transit surveyor will line up the chaining pin, used to mark the new point, with the vertical crosshairs of the telescope. The telescope should line up exactly on the pin so that the line measured will be kept absolutely straight. Then a stake is driven into the ground where the head pin was and a tack is placed in the top of the stake at that point. The tapeperson walks forward and the rear tapeperson follows until the chaining pin just set is reached. "Chain" is called out, and the head chainperson stops. They do the same thing again.

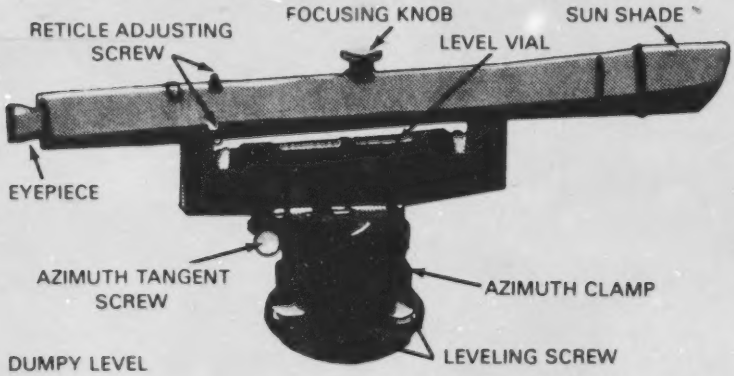
Then the rear tapeperson picks up the chaining pin at each station. The number of pins the rear tapeperson has is the number of hundreds of feet that have been taped.

Surveyors sometimes will make a quick estimate of a distance by pacing it off. A surveyor should have some idea of the length of paces and should learn how to do rough measurements by pacing. One way to do this is to measure off the length of a football field. This field is 300 feet long. The surveyor should pace the length of the field, return, and count up the total number of paces. Then the number of paces should be divided by 600 feet, the number of feet walked. The number that results, will be average number of feet in the surveyor's pace. To check the distance, the person then should pace off what seems to be 100 feet. Then the distance should be measured with a tape to check the accuracy of the estimation.

Another practice exercise, which uses all the information given so far, is to check a football field to see if it is laid out accurately. To do this, the surveyor selects one of the corners of the field and measures off lines to the two adjacent corners. A transit is set up over the first corner and the angle is measured between the two lines. Then stakes are set in each of these corners. The transit is moved to one of the adjacent corners and the process is repeated. From the measurements is calculated whether the field is in fact 300 feet long and whether all its angles are right angles (90° angles). If not, the error or errors are determined and located.

DUMPY LEVEL

In addition to the transit there is another instrument with a telescope commonly used in surveying. This is an instrument called the *dumpy level*. It has an 18 inch telescope rigidly attached to a level vial. The level vial is just beneath the telescope.

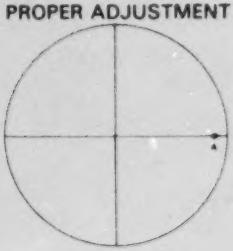


DUMPY LEVEL

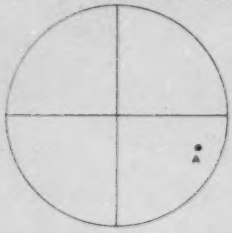
The telescope and vial swivel about on a footplate which is attached to a threaded collar. The collar then is screwed into a tripod, just as is a transit. In the eyepiece of the telescope are two crosshairs which cross each other in the center of the field of vision. The level is screwed into the tripod. Once the level is on the tripod, it should be adjusted. First the surveyor turns it around in a semicircle. The amount the bubble in the level vial moves off center is two times the error. The leveling screws should be turned back and forth until the bubble remains stationary as the telescope is completely turned around.

When the dumpy level has been leveled, the horizontal crosshair should be adjusted. A sharply defined object should be sighted with one end of the horizontal crosshairs through the telescope. Then the telescope should be turned so that the object moves to the opposite side of the field of vision. If the object does not remain on the crosshair, then the crosshair is not properly adjusted. Adjusting the crosshair is simple. One of the reticle adjusting screws on the telescope should be loosened and two of the opposite screws should be tapped lightly to turn the reticle slightly. Then the test should be repeated. The object should remain on the crosshair all the way across the field of vision.

PROPER ADJUSTMENT



IMPROPER ADJUSTMENT



Another test is often used to make sure that the line of sight on the dumpy level is correctly adjusted. This is done by driving two stakes into the ground about 300 feet apart. This can be done very handily on, say, a football field. The level should be set up half way between the stakes. A rodholder should hold a level rod, first, on one of the stakes and then on the other. The elevation of each of the stakes should be noted. Before we go any further, it might be useful to look at how the *level rod* operates. There are a number of types of level rods used. Usually they are wooden rods marked off in hundredths of a foot. The markings begin at zero, at the bottom, and go up to twelve or thirteen feet. It is made in two sections which slide over one another. The back section slides up and is clamped in place. The graduations are alternate strips of black and white. Each strip is exactly one-hundredth of a foot wide. The rod should be held straight up and down by the

rodholder. The instrument person, the person sighting through the level, then reads the rod from the mark which the horizontal crosshair of the instrument crosses. A bucklike target is often attached to the rod. It has a direct vernier on it which allows readings to thousandths of a foot. In checking the level, rod readings should be taken on both the stakes. The instrument person calculates the difference in elevation. The instrument should be moved close to one of the points. The rod is read through the eyepiece without the lens at A. Then the difference in elevation between the two instrument points is calculated and and expected rod reading for B is determined. The expected reading for B is the difference between the first and second reading of A, added to or subtracted from the first reading of B. Then the rodperson moves to B. If the expected number is not read, the instrument is misadjusted. The reticle on the level then should be adjusted.

HIGHWAY SURVEY

These are the basic jobs a surveyor does. Now let us look at an entire survey and see how it is done. Surveyors use all these steps when, say, laying out a path for a two lane highway. In a route survey, four things are done over and over again: 1.) Distances are measured with a tape. 2.) Angles are measured with a transit. 3.) Elevations are measured with a rod and a level. 4.) All of these measurements are recorded in field notes by the surveying party chief.

Let's see how these four tasks are done together in surveying a route profile for a highway. A route profile is done by setting stakes at measured equal distances along a path and then finding the elevation of each of these points. To do this the surveyor will use a level, tape, wooden stakes and a level rod.

The surveyor should set wood stakes 100 feet apart along the centerline of the route. Then the level should be set up at some point in between each set of stakes and off the right of way. The sight of each stake of the pair through the telescope should be more or less uniform. The surveyor begins by taking a back sight to a known elevation. The point which has a known location is called a *benchmark*. Then the surveyor calculates the height of instrument (H.I.). The H.I. is calculated by adding the reading on the rod to the elevation of benchmark. Then elevations are read at 100 foot stations and at any points in between where the direction of the road changes or where a sharp change in elevation occurs—at ridges, ravines, etc. Any places where bridges, culverts or road intersections occur should have the elevations checked very carefully. The instrument should be set up so that the distance between fore sights and back sights is about equal. It

should be moved and reset after each sighting. All elevations on the pavement should be made to hundredths of a foot. Each reading should be marked clearly in the field notes.

Keeping proper field notes is important. No matter how accurate the measurements of a survey are, they are worthless if they are not clearly recorded in notes. Notes are usually kept in a field notebook. They may be either permanently bound or in looseleaf. The notebook should include a list of people in the field party, a list of instruments used and a sketch and description of the project. There are three general forms of notes. These are tabulations, sketches and notes. Tabulations are recorded in columns headed by a notation of the type of instrument used, type of measurement and degree of accuracy. Sketches may be either to scale or larger than scale for accuracy. Also descriptions should be given. Descriptions may contain just a few words or many pages. Field notes may not be erased. If errors are made, the notation should be crossed out with a single line and the correction written in above it.

PROFILE LEVELING

In highway work profile leveling is used. Profile leveling takes a series of levels at 50 foot intervals along the centerline of the highway. The elevation of the whole route is plotted in between the points of measured elevation. Profiles are plotted out on a special type of paper called *Plate A Profile Paper*. Profile leveling simply takes a series of rod readings from any given location of the instrument, or turning point, (T.P.). When elevations are plotted in, a 10.1 scale exaggeration is used vertically. That is, if the horizontal scale is 1 inch = 400 feet, the vertical scale would be 1 inch = 40 feet.

After the elevations on the roadbed have been made and noted, the elevations of each measured point are marked on the profile paper. Then the plotted elevations are joined with curves. Once the elevation curve is calculated and drawn, the engineer will choose a grade line which will require the least amount of cutting and filling with the given elevations. A *grade line* marks off the number of feet the roadbed should rise or fall in each 100 feet.

CROSS SECTION LEVELING

In addition to profile leveling, another type of leveling done in road surveying is cross section leveling. At each station, 50 foot or 100 foot intervals, the surveyor should take cross section readings. Cross section readings are elevation readings along a line at right angles to the centerline of the road. The level should be set up at some point on the side of the road. Then the H.I. should be calculated from the backsight to a known point. Several foresights are taken along the cross section line at the first station. The rodholder should carefully pace off the distance from the point being shot to the centerline of the rod. Similar cross section shots should be taken at each station. With stations more than 150 feet from the instrument, a new, nearer, turning point (TP) must be set up.

OTHER SURVEYING ACTIVITIES

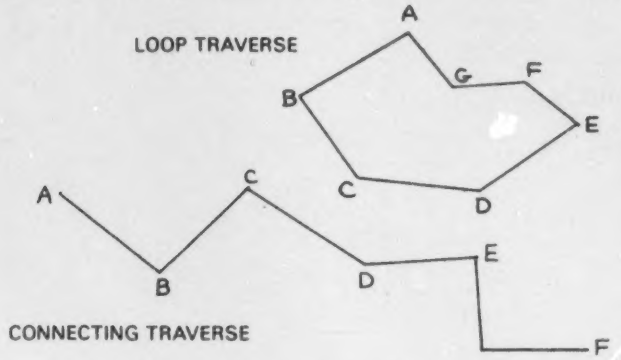
Surveyors do more than survey roads; they also locate and measure property and boundaries, and lay out routes for pipe lines electrical lines and so on. To do this the surveyor needs to be able to read the field notes of other surveyors and also legal descriptions of property. In addition to this, the other main skills of the surveyor (measuring angles with transits, measuring elevations with levels and measuring lengths with tapes) are all used.

Land surveyors often stake out the path of a pipeline. An example of this would be staking out a sewer line. The first thing to do would be to set stakes every 50 feet along the way and take the elevation of each stake. Then a profile is drawn up and a grade line is defined. The surveyor will then set up the level instrument at some point. The rod will be read at some point of known elevation and the H.I. will be established. For each station, the surveyor will subtract the grade elevation from the H.I. The grade elevation will come from the grade line. Then the actual elevation will be compared at each point with the grade elevation. This comparison is made by subtracting the grade elevation from the actual elevation. This will give the amount to be cut or filled. Finally, the surveyor adjusts the target on the level rod so that when the base of the rod is sitting at grade level the horizontal

crosshair of the level coincides with the center line of the target. Stakes are driven just deep enough that the rod can be set on them and the crosshair in the eyepiece of the level will coincide with the center line of the target.

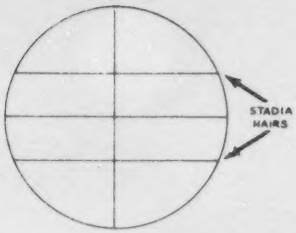
RUNNING TRAVERSES AND MAP AREAS

Besides setting grades for pipelines and rerunning old surveys, surveyors also run traverses and map areas. A traverse is a connected set of lines which run between points. The points are called *traverse stations*. The lines and angles are measured. Traverses are used to map areas and to serve as reference points for an area. Any of the traverse points can be used, say, as a starting point for a mètes-and-bounds survey. There are two kinds of traverses—*loop traverses* form a loop; *connecting traverses*



begin at a known point, go in a specified direction, and end at another specified point. Traverse stations usually are previously established benchmarks which can be easily found and measured. The actual steps in measuring a traverse are simple; they are repeated again and again as the traverse is made. The transit is set up at the traverse station. The instrument person sets the graduated plate at zero. To orient the instrument it is sighted along the line of magnetic North. This line is called the *azimuth*. Then the magnetic bearing data is recorded in the field book. Next the interior angle is turned between the two intersecting lines. This angle is recorded in the field book. Finally, the distance between one station and the next are measured with the tape and this information is recorded.

On traverses, transits are often used which have *stadia equipment*. Stadia-equipped transits and elevation rods can be used to measure direction, horizontal distance and elevation. Transits have two stadia hairs above and below the horizontal crosshair in



the center. The length falling between the two stadia hairs increases at a rate of 1 foot each 100 feet. That is, the distance between two points crossed by stadia hairs on a level rod will increase by 1 foot for each 100 feet distant the rod is. A level rod 400 feet away from the transit will be seen with stadia hairs crossing it 1 foot further apart than if the rod were 300 feet away. The distance between the two points on the rod multiplied by 100 is equal to the distance of the rod from the instrument.

STADIA SURVEY

Surveyors practice making surveys using stadia-equipped transits and level rods. These are the steps needed to do a stadia survey. First, the surveyor would set up the instrument at a convenient point and would take the H.I. simply by standing the rod up next to the transit and measuring the distance to the ground. Then the instrument would be oriented to magnetic North and the angles turned. The angles are recorded. The elevation of each point to be measured is taken from the middle hair in the eyepiece (the horizontal crosshair). Then at each reading the distance is recorded between the two points on the rod intercepted by the stadia hairs.

SURVEYING A BUILDING SITE

One other kind of survey which surveyors make is a survey of a building site. All the features of the site must be noted and the site must be mapped. Although building sites vary widely, here are some of the things that a surveyor will need to do. First, the surveyor takes a small scale map of the city which lists almost every feature. (Such a map is often called a *plat*.) The plat will be studied. Property corners, water mains, sewer lines, gas lines and so on will be located. The site will be reviewed and the property corners located. In each corner will be set a permanent marker—usually an iron stake or a pipe. Then the surveyor measures the property lines and the distance from the property lines to electric poles, electric lines, water lines and gas lines. Next is measured the length of the utility lines. The width and length of sidewalks should be measured, as well as their distance from

property lines. The location and types of trees should be noted. Elevations should be taken both on sidewalks and curbs. These elevations should be to the nearest 1/10 foot. The width of the adjacent street or streets should be noted, as well as the name or names. Elevations should be taken on the sewer line and its gradient should be calculated. This should be done to the nearest 1/100 foot. The site should be divided into 50 foot squares and elevations should be taken at the corners. Finally, a sketch should

be made of the site and later a map of the site should be drawn. Then the surveyor should measure the distance from the corners of the building to the property lines and set stakes at the corners.

These are the major things surveyors do. Each of the steps described has variations, but these are the most commonly used procedures.

TOOLS AND EQUIPMENT
SURVEYING

Architect's rod—a type of 2-section leveling rod which is similar to the Philadelphia, but graduated in feet and inches to the nearest 1/8 inch, rather than decimally.

Chaining pins—steel pins used to mark the ends of the tape while measuring distances.

Detroit rod—a type of leveling rod which is available with 3 or 4 sections which, instead of sliding, are joined end-to-end.

Dumpy level—a type of engineer's level which has the telescope rigidly fixed to the supporting frame.

Engineer's level—the instrument most commonly used to attain the level line of sight required for differential leveling. It is mounted on a tripod, usually with adjustable legs. Mounting is done by engaging threads at the base of the instrument (called the foot plate) with the threaded head on the tripod.

Frisco rod—a type of leveling rod used for direct reading only. It is available with 2 sections or with 3 sections.

Leveling rod—a measuring stick used in conjunction with the engineer's level. It is usually graduated to hundredths of a foot.

Philadelphia rod—probably the most frequently used leveling rod. It consists of two sliding sections which can be fully extended to a total length of 13.10 feet. When the sections are entirely closed, the total length is 7.10 feet.

Plumb bob—a pointed weight suspended on a flexible cord used to see an instrument directly over a point. Also used in taping distances.

Range pole—a stick or pole which has a sharp point and is painted in alternating red and white stripes. It is used as a sighting rod.

Self-leveling level—a type of engineer's level equipped with a small bull's eye level and three leveling screws. The leveling screws, which sit on a triangular foot plate, are used to (approximately) center the bubble of the bull's eye level. The line of sight automatically becomes horizontal and remains horizontal as long as the bubble remains approximately centered.

Stadia rod—a ten or fifteen foot rod used in conjunction with stadia surveying. It is usually graduated to tenths of a foot, however any level rod may be used.

Steel tape—a nickel-steel alloy, reel-type measuring tape graduated to tenths of a foot. Usually 50 feet or 100 feet long.

Transit—an instrument which revolves about either a vertical or horizontal axis. It can be used to measure horizontal and vertical angles, distances by stadia and direction.

Tripod—a three-legged stand on which a transit, level or engineer's compass may be mounted.

Wood stakes—short, pointed stakes of wood used to mark turning points, hubs or other critical stations on a survey.

Wye level—a type of engineer's level which has the telescope supported in two rings which can be opened, allowing the telescope to be turned end-for-end or to be rotated.

GLOSSARY
SURVEYING

Azimuth—the direction of a line as given by the angle between that line and the meridian (usually North, sometimes South).

Backsight—a sight taken to a point of known elevation.

Bearing—the direction of a line with respect to any meridian.

B.M.—bench mark—a fixed reference point of known elevation.

City plat—a map showing the subdivision of city lots.

Contour interval—the vertical distance (elevation change) at which contour lines are drawn.

Contour line—a line connecting points of the same elevation.

Corner—in surveying, a monument placed to mark (corner mark) the corners of land property.

Cut or fill—terms used in connection with earth work. If earth is to be removed from an area, the operation is said to be a cut. If earth is to be brought into an area, the operation is said to be a fill.

Elevation—the height above sea level or the distance above or below a reference or grade line.

Field notes—all data, explanatory notes and sketches taken by a surveyor on a job and entered in a field book.

Foresight—a sight taken to a point whose elevation is to be determined.

Grade line—in construction surveying, a string line marking a reference elevation for the structure being erected.

Gradient (grade)—the slope or rate of rise or fall of a line—usually expressed as a percentage.

H.I.—height of instrument—a number determined by adding the distance read on a level rod, held on a B.M., to the elevation of the B.M. Used for determining elevation differences.

Hub—a point over which the transit is set for a series of readings.

Meridian—a North-South line.

Metes and bounds—a survey which has the lines determined by bearings and lengths.

Monument—a permanent mark placed at the corners of a piece of property to establish land lines.

Orient—to set the instrument so that the main scale reads "O" when the instrument is aligned with a true or magnetic meridian.

Plunge the telescope—invert the telescope of a transit.

Shot—a reading on a level or stadia rod.

Station—points which are marked by stakes at measured intervals along a fixed line.

T.P.—turning point—an instrument from which both backsights and foresights are taken.

Traverse—a succession of straight lines connecting established points. A "closed traverse" is a traverse which closes itself to form a polygon. An "open traverse" is a traverse which does not close itself.

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Spier, R. F., *Surveying and Mapping: A Manual of Simplified Techniques*, (Holt, Rinehart, & Winston: 383 Madison Avenue, New York, New York 10017), 1970.

ADDITIONAL SOURCES OF INFORMATION

Construction Surveyors Institute
420 Lexington Avenue
New York, New York 10017

American Congress on Surveying and Mapping
733 E. 15th Street, N.W.
Washington, D.C. 20005

TESTING AND INSPECTING

INTRODUCTION

Inspectors are individuals who examine materials and/or workmanship to insure that they meet minimum standards and pre-determined specifications. In the construction industry, inspections are carried out by professional inspectors who monitor construction projects, as well as by construction workers who inspect what they have done as their work progresses. Inspectors are at work on a construction project from the moment the project begins until the final inspection is completed and the building is opened for use. There are basically three types of inspections which may be made—inspections by government, inspections by private sources and inspections made by the builders themselves.

CONDUCTING INSPECTIONS

When a construction project is designed, the plans are submitted to the building department of at least one level of government: City, County, State or Federal. Here the plans are inspected to insure that they conform to the applicable building codes. While the construction is in progress, governmental inspectors will come on the building site to see that safety regulations are followed and that installations such as plumbing, wiring and heating conform to the applicable building codes. Finally, when the project is completed, it is often required that a final governmental inspection take place and a report filed before the building can be opened to public use or sale.

Inspections made by private sources include the loan company or bank which financed the project and inspections made by the project's insurance company. The former are supposed to insure that the project is progressing according to the plans and the latter are to insure that the project is done safely. Another area where inspectors from independent sources (as well as government sources) are called in, is the investigation of building failures. Inspectors who study building failures are like detectives—they work from the evidence available at the scene of a construction failure to determine the cause of the failure. Their conclusions may indicate that faulty planning, faulty materials or faulty workmanship was responsible.

Inspections made by the builders take place while the construction is in progress. Quality control tests are carried out by the project superintendent or assistants at all phases of the project to insure that the work is being done completely. In addition, the

owner or architect may also send inspectors to determine whether the project is being carried out according to plan and on schedule.

Generally speaking, inspectors monitor one or more of the following – the quality and quantity of materials used on a project, the practices of the construction workers and the quality and safety of the finished workmanship.

TESTING AND INSPECTING CONSTRUCTION MATERIALS

Almost all construction materials are tested and inspected before being marketed: The tensile strength of steel, the holding power of nails, the strength of glass and the color-fastness and durability of paints are examples. At the construction site, materials are

monitored to insure that they at least conform to the minimum standards set down in the building specifications. Some building materials have a quality mark stamped on them. In this case, all the inspector has to do is insure that the quality mark on the material conforms to the quality called for in the specifications. On other occasions, a materials inspection requires a wide variety of elaborate tests – such as tests of soils and concrete aggregates.

MONITORING PRACTICES OF CONSTRUCTION WORKERS

The practices of construction workers are monitored to insure that safety codes and requirements are met and to insure that their work conforms to the building codes and specifications. An example of this is the practice of checking to make sure that reinforcing steel is properly set before concrete is placed.

Inspectors, finally, will monitor the finished workmanship. Wiring installations, for example, must be tested to insure that they will not short out and they conduct electricity properly and safely;

also, welds are sometimes x-rayed to make sure that there are no hidden soft spots or weaknesses.

FILING REPORTS

At all stages of a construction project the inspectors file reports of their findings. This means that in addition to actually carrying out inspections, a competent inspector must have the ability to write concise and informative technical reports.

QUALIFICATIONS OF AN INSPECTOR

What are the qualifications of an inspector? First of all, a good knowledge of the building trades is essential. A thorough knowledge of material grades and construction methods used in working with the materials is equally important. In addition, it is important to be able to read and understand blueprints and engineering/architectural specifications.

A strong background in math and, perhaps, engineering or construction technology are common among construction inspectors. This may include a junior college course of study in engineering or construction technology, or a bachelor's degree in engineering from a college or university. Construction technology course work may include architectural drawing, technical math, applied physics, applied chemistry, technical report writing and construction methods and materials.

Inspectors are employed at all governmental levels. The Federal government employs inspectors in a number of departments—particularly in the Departments of Defense, Interior, Commerce, Transportation and Housing and Urban Development. New opportunities for safety inspectors in government developed from provisions of the Occupational Safety and Health Act of 1970.

Further information on construction inspecting may be obtained from:

American Association of Construction Inspectors
Box 1234
New York, New York 10008

The International Association of Electrical Inspectors
201 E. Erie Street
Chicago, Illinois 60611

COMMON TESTS AND INSPECTIONS

Let's look more closely at some of the common types of tests and inspections. One test is of concrete form work. Forms should be inspected before concrete is placed to make sure that the joints

are tight enough to keep mortar from leaking out. Braces should be installed and attached firmly so that the form will not bend or buckle. Last, the forms should be checked to make sure that they do not have serious flaws and are well-oiled so that they may be stripped down easily.

Concrete Mixes

Concrete mixes are themselves tested for thickness and consistency by a *slump test*. The slump test measures the stiffness or thinness of the concrete. Inspectors make slump tests in the following way: First, a sampling cone is filled four inches high with a random sample of concrete. The sampling cone is made of 16 gauge metal. The bottom and the top are open. The cone varies from 8 inches in diameter at the top to 4 inches in diameter at the bottom. The concrete should be rodded exactly 25 times with a standard rod. This rod is 5/8 inch in diameter, 24 inches long and shaped like a bullet at the end. Another 4 inches of concrete should be added and the rodding should be repeated. Then the cone should be filled to the top and once again the mixture should be rodded down. The cone should be placed upside down over a flat piece of plywood. Then the cone should be gently lifted. The concrete will be dumped out. The flat cone should be set next to the concrete and the 5/8 inch diameter rod should be laid on top of the cone so that it hangs out over the concrete. Last the distance from the bottom of the rod to the top of the concrete should be measured to the nearest quarter inch. This distance is called the "slump" of the concrete. Usually a slump of 1 inch to 6 inches is used on commercial cement jobs.

Cement Compression Test

Another test frequently made on cement is a *compression test*. In the compression test, four or five cylinders are filled with concrete. The cylinders are placed in a wet, humid room and cured for 3, 7 or 28 days, depending on the specifications. At the end of this time they are removed from the curing room. The ends of the cylinders are capped with molten sulfur or molten lead so that the weight load will be distributed evenly throughout the cylinder. The cylinder should be placed in a testing machine and pressure on it should be increased until the cylinder fails. The information which should be noted includes the load at which the cylinder fails, the cylinder identification number, area in cross-section, the maximum load which the cylinder will bear, the way the cylinder fractures, defects in the cylinder and the age of the cylinder.

Reinforcing Steel And Aggregates

Inspectors also make visual inspections of reinforcing steel, and also aggregate material (the sand and gravel which will be mixed into the concrete). Inspectors look for defects in these materials which would make it difficult for the concrete to form a firm set. The reinforcing steel should not have oil, grease or anything else on it which would keep it from forming. The aggregate material should have sharp corners and edges. There should be no clumps of mud or other impurities in the aggregate. Inspectors watching the job being done should make sure that the batch is not over vibrated. If concrete is over vibrated the heavy aggregate separates out and the bonding is bad. Finally, inspectors should make sure that the concrete is not placed in freezing weather.

Brick And Tile Tests

Brick and tile are often tested to find out how much water they will absorb. Each brick or tile should be weighed dry. Then they should be placed in boiling water for 5 hours. They should be removed and weighed again. Then the percentage of absorption should be calculated. The percentage can be figured by this formula: $A = \frac{W2 - W1}{W2} \times 100$. In this formula, A is the absorption in percent, W2 is the weight after soaking, W1 is the weight before soaking. Brick should not absorb more than 20 percent of its dry weight. Clay tile should not absorb more than 16 percent. Concrete tile should not absorb more than 10 percent. Often, too, masonry units such as tile or brick will be subjected to compression tests. The ends of each brick or tile should be covered with an even layer of gypsum plaster. Then the tile or brick are placed in a testing machine. The testing machine will crush the material. The weight at which it crumbles should be noted. The cross-sectional area of the tile or brick should be calculated. Then the load which breaks the masonry should be divided by the area which is placed under pressure. The result gives the pressure in pounds per square inch. Brick used in construction should be able to bear at least 2500 pounds per square inch. Clay tile should bear at least 700 pounds per square inch.

Masonry Tests

Masonry is also tested and inspected in a wide variety of ways. Precast masonry units are inspected before they are actually used in construction. Shipments should be checked for color, cracks, broken units or any other defects. The percentage of defects should be estimated. Mortar is often field tested. The mortar mix should be checked to be sure that it is of the proper consistency.

The inspector should be sure that bricks are wet before they are laid, that a full mortar bed has been troweled and that vertical joints are full. Finally, checks should be made to be sure that brick fragments are not used.

Wood Tests

Wood is another construction material which undergoes a wide variety of tests and inspections. One test measures the amount a board will flex or bend under a given amount of weight. The inspector should take a board which is about 15 times longer than it is thick. If a 1/2 inch 2 x 4 were to be tested, the tester would take one about 30 inches long (30" = 15 x 2). The board should be checked to make sure that it has no special defects or reinforcements. Then it should be suspended between two rigid supports. The ends should be kept in place with rocker plates. Two nails should be driven into the beam over the bearing plates. A wire should be tied between the nails. A scale should be attached at the midpoint of the beam. The beam should be evenly weighted down through the bearing plates. The bending of the board (deflection) should be measured. The weight at which the board breaks should be noted. In a report on such a test, the beam should be described as to its type, whether it is laminated or not and its dimensions. A diagram of the supports should be drawn. The device used to measure deflection also should be drawn. Finally, the way the wood failed, or broke should be made.

Many tests are run on plywood. It is inspected to make sure that it is straight and that it does not contain too many knotholes. Also, plywood is tested to discover its tolerance to stress and strain. This is done by mounting it between two stands and piling on sandbags until the plywood breaks.

Steel Tests

Another material frequently tested is steel. Several different tests and inspections are made of steel. Inspectors should be able to read test reports to make sure that contract specifications are met. Mill test reports should be obtained from the steel supplier. Then the inspector should see that the steel specified is the same as that ordered. ASTM (American Society for Testing and Materials) standards should be checked for allowable standards. The chemical content of the steel as shown by the mill tests should be in the range allowed by the ASTM. Tensile strength and hardness as shown by test should be within the ASTM range allowed.

Welds are almost always checked in the field. The weld should not have any holes, slag or spatter. There should be no overcuts or undercuts on the parent metal.

BUILDING
INSPECTOR

When paint jobs are inspected, containers should be checked to make sure that the paint actually used was the paint specified. The inspector should see that the paint is compatible with the primer used. Finally, the finished job should be checked to be sure that there are no drips or runs.

When steel joists are inspected they should be checked to make sure they are straight. Welds should be checked. The way the joist was erected should be checked to make sure it was put up according to the manufacturer's directions. A joist should be tested by suspending it between two stands and weighting it down until it breaks. The breaking point should be noted and compared to specifications to make sure the joist is strong enough.

Steel roof decking should be inspected to see that it is not warped, kinked or excessively bent. The way the deck is installed should follow the manufacturer's directions. A panel should be tested as was the joist. The weight at which it fails should fall within the specified strength.

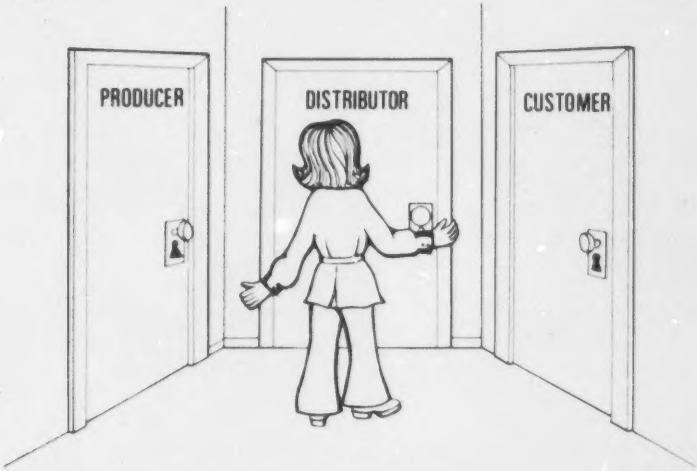
These are the major tests and inspections made on most building projects. A person who knows how to make these tests is on the way to becoming a good inspector.

MARKETING FUNCTIONS

INTRODUCTION

In order to intelligently discuss the distribution of construction materials, it is first necessary to have a basic understanding of the general process by which all merchandise is distributed. Whether we talk about the distribution of pizzas or television sets, computers or plywood, the distribution process is basically the same.

Probably the easiest way to gain an overall understanding of the distribution process is to look at it in terms of *marketing functions*. Marketing functions are generally defined as operations involved in the "flow" of goods and services from the producer, to the distributor, to the customer. Most marketing people think of these activities as being; merchandising, supply and facilitating functions.



MERCHANDISING FUNCTIONS

Let's begin by taking a look at merchandising functions. The first of these can be called, "innovative product planning and development." This function underlies the modern concept of marketing, and the skill with which a company performs it determines in great measure not only its success as a producer, but also its success as a marketer. The wise company does not ask itself "How can we sell what we make?", but, "How can we make and sell what people will buy?" This calls for creative marketing planning which focuses, not on the company or on its product, but on the potential customer.

The second merchandising function is standardization and grading of products. Standardization, as the name implies, includes the setting up of recognized standards for such matters as quality, quantity, size, weight and color. Standardization makes grading possible; for, once the criteria is determined, products can be properly classified. Rules governing standardization and grading have been set up not only by governmental action, but also by consumer-oriented organizations. Their application has helped to establish product confidence in participants all along the marketing line, because they know they are getting what they are paying for. A buyer can order from his supplier by mail, wire or telephone without the necessity of going to the seller's storage facilities to inspect the products, knowing that the mention of Grade A, B or C spells out distinctive characteristics which are understood and accepted by both buyer and seller. Standardization and grading, therefore, make for easier contractual agreements.

A third merchandising function is selling, and it is around this function, that sales promotion plans are developed. These will differ with the product to be sold, but the seller must take the initiative in announcing that a product is available, that it fulfills a need, and that its price is right. Each producer/distributor will use the means which is decided to be best suited. If, for example, the product is designed for industrial use, the producer/distributor will send an engineer-salesperson to selected companies. The producer/distributor may list, with pictures, products in a catalog which are mailed to selected buyers. The products may be advertised in trade publications, some of which circle the globe. If, on the other hand, the product is designed for consumer use, the seller can promote through advertising in newspapers, magazines, radio, television, catalogs, posters and descriptive literature sent through the mails.

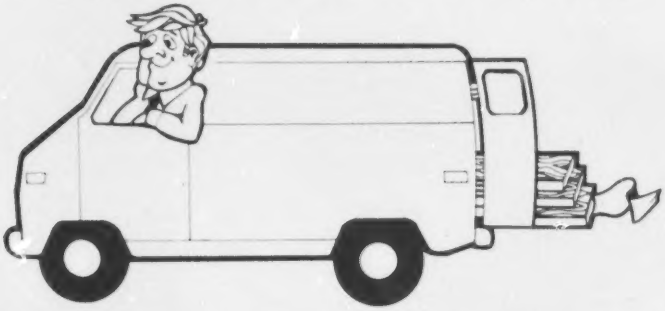
SUPPLY FUNCTIONS

The second major group of marketing functions is designated as functions of supply. There are two of them, and they have to do with the actual handling of the goods themselves. The first of these functions is storage and the second is transportation.

Storage makes possible a control over marketing operations that would otherwise be lacking. For example, if the producer wishes to buy raw materials in advance of their actual use, this can be done if there is a place to store them. Additionally, if there is storage space, the production of the finished product can be done well before it is placed for sale. Such arrangements allow the producer to keep both employees and machinery more steadily at

work and thus avoid costly peaks and valleys in the production line.

Storage facilities also help a distributor, such as a wholesaler, to keep on hand the supply of products needed for resale to customers. Equally important are storage facilities for retailers, who must have on hand a sufficient backlog of requested items so that goods are immediately available for customer purchase.



Transportation plays a vital role in marketing. Were it not for trucks, railroad cars, ships and planes which bring food, clothing, construction materials and scores of other products from their point of production to the marketplace, American businesses and households would be hard pressed to meet their daily routines. Indeed, so dependent are we upon transportation, that any work stoppage which delays delivery of goods can snarl the marketing system. If the movement of any consumer product is delayed so that it is not on the shelf of the retailer when a customer asks for it, the retailer will probably lose a sale. It is evident then, that a reliable mode of transportation is essential to successful marketing.

FACILITATING FUNCTIONS

Facilitating functions, the third group of marketing functions, are sometimes called aiding or auxiliary functions. Included in this category are financing, obtaining and interpreting marketing information.

In theory, every marketeer who does a good job earns a fair share of profits. To achieve this, those in marketing must have dependable financing and credit. This is true for all businesses, not only because of the risk involved, but also because more frequently than not the buyer's payment for the product or service is not simultaneous with its purchase. Therefore, the seller must have adequate financial resources to keep the business moving along steadily between customer-payment periods.

Producers, manufacturers, wholesalers, retailers all face this situation, the need for adequate financing. Wholesalers, for example, need capital to finance their storage plants, packaging and transportation equipment. Retailers are equally dependent on good financing and credit backlogs, for they, too, must carry on their day-to-day business against a background of risk-bearing and customer charge accounts. Financing, therefore, is a vital function of the marketing process.

Obtaining and interpreting marketing information is important for obvious reasons and is done in many ways. It may be continuous marketing research carried on by the company itself or it may be a matter of hiring an outside consultant to do a research study on a specific project. Whatever the method, the data used in the research must be accurate, meaningful and interpreted with an eye to the particular marketing problem at hand.

These, then, are the three major groups of marketing functions and their components. Clearly, no one of them operates independently of the others. Quite the contrary is true, for each is dependent on one or more of the others in the constant interplay of factors which promote the free enterprise marketing system.

THE DISTRIBUTION OF CONSTRUCTION MATERIALS

Like other goods and services in a free enterprise marketing system, construction material distribution is governed to a large extent by the marketing functions discussed in the preceding section. This type of distribution has certain unique characteristics.

The purpose of the building material distribution industry is to procure, transport, warehouse and deliver all materials needed by the building industry. This gathering and warehousing must be done efficiently and economically in order to maintain a competitive price. As a support service, the distributors must also communicate to the building industry where and what is available and at what price. This function is called advertising.

Providing the materials for the second largest industry in the nation has evolved into a highly sophisticated activity which utilizes the most modern methods and computerized equipment. Since distribution is highly competitive, it must constantly seek more economical methods. This necessity for efficiency and economy produces an ever-changing picture of who sells what – and at what price. A firm simply cannot continue stocking an item if it becomes unprofitable to do so.

Any attempt to list all building materials now in use would be a major undertaking. However, the complexity of this maze of

products can be visualized by considering that the building industry employs nearly five million workers in a wide range of jobs. About half of these workers are employed in electrical, air conditioning, plumbing and other specialized areas; about one third are employed in the general building area; the remainder are engaged in building dams, bridges, roads and similar heavy construction projects.

The distribution system associated with handling building materials products, has developed from the small lumberyard by the side of the railroad track—which handled only lumber—into highly specialized wholesale and retail outlets and gigantic mass merchandising systems. Whatever type of outlet can handle a particular product the most efficiently (meaning the most economically), determines the channel of distribution for that product.

The Lumberyard

The local lumberyard remains the major supplier to the general customer. It is the "general store" for the industry. Lumberyards today stock a large variety of products and are in a position to order items they do not stock. In order to sell their products, modern lumberyards provide such services as material estimates and financial counseling. They are a communication center for the building contractor and customer.

The Discount House

A recent development in the distribution of building materials is the building materials discount house. These mass merchandising firms are located in large and medium-sized cities. They provide ample parking space and have checkout counters much like those in grocery supermarkets. Their aim is to procure large quantities of high volume items, provide only limited customer services and sell at a discounted price. This type of distribution has proven successful and is especially popular with do-it-yourself customers.

All products handled by lumberyards and mass merchandisers, as well as a number of related products, can be purchased from specialized suppliers. These outlets specialize in such areas as plumbing, electrical supplies, heating and air conditioning, paint and wallpaper, floor covering, sheetmetal, glass, paneling, siding, masonry products, roofing and insulation. These outlets normally provide complete customer services. Besides selling all materials and supplies in their specialized areas, they often estimate, build, install and provide financial counseling and product information.

EMPLOYMENT IN CONSTRUCTION MATERIALS DISTRIBUTION

Broadly speaking, construction materials distribution involves the entire range of activities described in the "marketing functions" sections of this manual. Thus, the person driving a truckload of electrical wire from the manufacturing company in Philadelphia to a warehouse in Milwaukee, the manager of the warehouse, the wholesaler who buys the wire in quantity and the retail salesperson who ultimately sells a twenty-foot length of wire, are all involved in the same distribution process.

Let's concern ourselves here with only one end of the distribution spectrum—the actual wholesale and retail outlets. These are probably the largest source of entry level job opportunities in the distribution chain. Included in this category are lumberyards, building materials discount stores (mass merchandisers), large department stores and individual specialty businesses such as paint and wallpaper stores, plumbing supply houses, air conditioning and heat suppliers and floor covering companies.

Why are there so many entry level (no experience required) job opportunities in this particular field? A number of factors are involved, including the sheer size of the construction industry—which is expected to continue growing for some time. Another attractive feature is that education beyond high school, except in highly specialized areas, is normally not required in this field. Generally speaking, high school courses such as drafting, general business courses and distributive education or industrial cooperative training provide an adequate background for a beginning job in a construction materials outlet. This does not mean, however, that it is not possible to advance in this field. On the contrary, with experience, self-education and hard work, it is possible to advance to a very high position or go into business for yourself.

WORK PERFORMED

Let's look for a moment at the work performed in a building materials distribution outlet. Regardless of the type of outlet—whether wholesale or retail, a small lumberyard or a huge discount house—it has four basic functions. These are buying, receiving, storing and selling.

Buying

Buying is a function usually performed by an older, more experienced employee or the owner of the outlet. To be a store buyer, of course, requires knowing exactly what can be expected to sell and at what price. There are always limitations in the form

of store space and money. The buyer must use all experience and knowledge to buy a well-balanced stock from a competitive view point—which may include buying some goods which are more for customer convenience than for realizing a profit on the sale. Normally, the buyer is the head of a department and is responsible for the overall profit of the department, although sales people often participate indirectly in the buying function by keeping the buyer informed on customer buying trends and preferences.

Receiving

When the merchandise is received, a receiving record is made. Reports are made on shortages, overages and breakages, and this information is checked against the vendor's invoice. The merchandise is then marked for price and put in stock or storage. In the case of chain stores, where merchandise comes from a central storage point, the merchandise is normally already marked for price. The price tag is often an electronic data processing card. When the item is sold, this card is removed and sent to the central buying headquarters, which uses the information for re-ordering.

Storing

The storing process requires constant attention to maintain the merchandise in attractive, good condition. This includes keeping inventory records, maintaining a good display and/or arrangement of merchandise, utilizing the facilities of the store to a maximum of efficiency and keeping a clean and neat store.

Selling

All store activity supports the most important function of the store—selling. If a store does not sell enough, there is simply no way it can survive. Methods for maintaining a good sales volume include advertising, store displays, a good store-public relations program and courteous, well-trained salespeople.

JOB DESCRIPTIONS

The following job descriptions are typical of those found is most building material outlets today. By studying the job descriptions you can see where you would be most likely to "fit in" such an organization and gain some understanding of the organizational structure typical of this industry.

General Manager (often the owner or corporation president)

- -sets company policies
- -supervises all operations
- -personnel management
- -determines merchandise lines to be carried by individual departments
- -approves all expenditures
- -arranges financing
- -determines general marketing strategy of outlet

Assistant Manager

- -assumes responsibilities of general manager in the general manager's absence
- -usually does the purchasing for one or more departments
- -estimating
- -advertising and promotion
- -sales to specific accounts

Department Head

- -supervises employees

KNOWLEDGE NEEDED

What are some of the things a person should know in order to do a job in material distribution? One thing is which companies manufacture which products. Further, a person should be aware of the specific features of similar products manufactured by different companies, and should know how each of the products sold is used.

This knowledge can be acquired by careful study. For instance, if a person sells paint, the salesperson should be familiar with each of the different paints sold and with the particular uses to which each paint will be put. One paint company may manufacture a

very fine paint to be used on outdoor wooden surfaces; another may manufacture a fine paint for outdoor metal surfaces. Still a third company may manufacture a good indoor paint, but not in a color required by a customer. A fourth company may manufacture an acceptable paint in the desired colors.

To hold a job in material distribution, a person might learn about different wood products and how they are used. It would be useful to know the manufacturers of different wood materials and which companies specialize in which materials. Masonry materials, also, are made by a wide variety of companies. There, further, are a wide range of masonry products on the market. If a person knows the major manufacturers of brick, tile, concrete block, cement and so on, this will be valuable knowledge and will be useful in marketing. If a person wants to sell metal products, it would be helpful to know the major manufacturers of iron, steel and aluminum products.

People who will work for flooring companies should be familiar with the manufcturers of resilient flooring and carpets.

One way to learn about manufacturers and products is to visit building products dealers and learn which products are sold. Another way is to obtain catalogues from manufacturers of different building products.

Besides knowing the products which are available, a person should know the different ways in which sales are made. Cash sales are made differently than are credit sales. Discounts vary depending on the quantities of materials sold, the credit agreement reached and so on. The salesperson should know which materials can be returned and under what conditions, and also what warranties exist. Finally, a salesperson should know which materials may be ordered and which are simply unavailable. Much of this knowledge comes with experience and knowledge of a particular firm, and can only be obtained by being observant and alert.

GLOSSARY

MARKETING FUNCTIONS

Advertising—any form of paid public announcement or presentation which is aimed at the promotion of the sale of goods or services.

Billing terms—any conditions which must be met before an order is accepted, such as time limitations and discount rates.

Broker—an agent who buys and sells on a commission basis.

Consignee—the person or business to whom a shipment of merchandise is addressed.

Distribution—the movement of merchandise or commodities from the producer to the final consumer. It is a broader term than *marketing*, since it includes not only the advertising, selling, packaging and similar activities, but the physical movement and preparation of the goods as well.

Equity—the net investment which a person has in some enterprise, business, property, etc.

Franchise—the right to market a given product which is granted by the manufacturer of the product.

Gross amount—the total sum or amount before deductions are made.

Interest—the price or compensation paid for the use of money over a period of time.

Inventory control—the process of maintaining inventories at the optimum level from a competitive point of view.

Invoice—an itemized account of goods sent or services rendered.

Liquidation—the conversion of assets into cash, either to close out a business or to take profits.

Marketing functions—operations involved in the flow of goods and services from the producer to the distributor to the customer.

Net amount—the total sum minus deductions such as discounts, charges or expenses.

Overhead—the costs involved in conducting a business.

Packing slip—a list of the detailed contents, weight and other required information about the contents of a shipping package, usually placed in a special envelope on the outside of the package.

Receiving report—an account of shortages, overages and breakages in received merchandise.

Retailer—one who sells to individual buyers merchandise which is not to be resold.

Sale on consignment—an arrangement under which goods are delivered to a merchant with the understanding that he will not pay for them until he sells them.

Stock in trade—merchandise kept ready for sale.

Trade association—an association of business firms or merchants for the purpose of promoting their common interests.

Wholesaler—a dealer who buys in order to sell to retailers.

Working capital—funds required for the actual operation of a business.

APPENDIX
MARKETING FUNCTIONS

Building Materials Technology and Selling, Austin, Texas: Distributive Education Instructional Materials Services, Division of Extension, The University of Texas, 1972.

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Palusci, Larry, *Profitable Retailing of Building Supplies*, (Cahners Publishing Company, Inc.: 89 Franklin Street, Boston, Massachusetts 02116), 1969.

Smith, R. C., *Materials of Construction*, (McGraw-Hill Book Company: 1221 Avenue of the Americas, New York, New York 10020), 1966.

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ABSTRACT: THE PURPOSE OF THIS INSTRUCTOR'S GUIDE IS TO OUTLINE A SERIES OF TRAINING EXPERIENCES RELATED TO WORKING WITH METAL THAT CAN LEAD A STUDENT TO AT LEAST ENTRY-LEVEL JOB PROFICIENCY. THE GUIDE IS DIVIDED INTO SEVERAL TEACHING UNITS, EACH WITH AN OVERALL OBJECTIVE. THERE ARE FURTHER DIVISIONS LISTING SUBOBJECTIVES WHICH, WHEN SUCCESSFULLY COMPLETED BY THE STUDENT, WILL SATISFY THE OVERALL OBJECTIVE FOR A SPECIFIC UNIT. SUGGESTED ACTIVITIES ARE LISTED UNDER THE SUBOBJECTIVES AND ARE SUPPORTED BY A NUMBER OF TEXTS. SOURCES OF INFORMATION AND AN OUTLINE OF "ACADEMIC RELATED THEORY AND INFORMATION" ARE ALSO INCLUDED IN EACH UNIT. UNIT TITLES FOR THIS GUIDE ARE: WELDING, SHEET METAL, PLUMBING, PIPEFITTING, AIR CONDITIONING AND HEATING, AND MILLWRIGHTING AND INDUSTRIAL MECHANICS. APPENDED IS A SAMPLE LESSON PLAN. THIS DOCUMENT SHOULD BE USED IN CONJUNCTION WITH THE STUDENT MANUAL FOR METAL (VT 102 414 IN THIS ISSUE). (AUTHOR/LJ)

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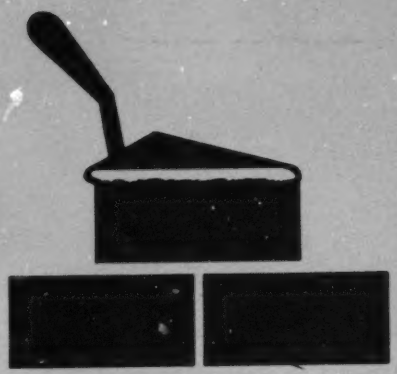
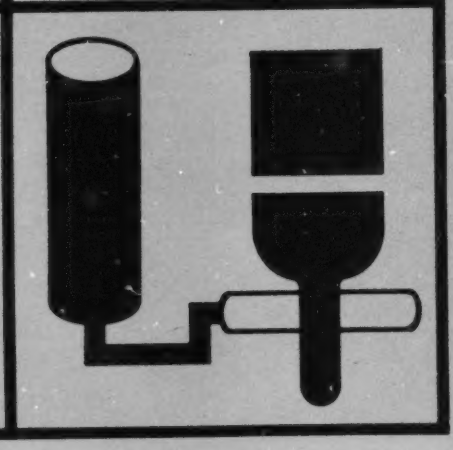
METAL





construction industry series
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2

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This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

EXPLORATION LEVEL:

Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

OCCUPATIONAL PREPARATION LEVEL:

Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
Metal - Student Manual
Metal - Instructor's Guide
Electricity - Student Manual
Electricity - Instructor's Guide
Masonry - Student Manual
Masonry - Instructor's Guide

In addition, there is an Articulation Guide designed for these instructional materials in construction.

Articulation Guide - Construction Industry Series

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INTRODUCTION TO METAL OCCUPATIONAL PREPARATION

PURPOSE

The purpose of this guide is to outline a series of training experiences that can lead a student to at least entry-level job proficiency. The instructor guide is divided into several teaching units, each with an overall objective. There are further subdivisions listed as sub objectives which will satisfy the overall objective for a specific unit when successfully completed by the student. Suggested activities are listed under the sub objective and are supported by a number of texts.

Use of behavioral objective format may or may not be new to you. There are a few basic components which acceptable behavioral objectives must include. First, all behavioral objectives must be directed toward student performance. Second, they must clearly state action or behavior which a student must perform. Third, there must be some criteria by which you can measure the success or failure of that action or behavior.

The establishment of a series of measurable goals for each student can individualize the education and training process. If a student can demonstrate skill in certain basic tasks to the satisfaction of the instructor, the student can move on to tasks which are more challenging. Instructing all of your students in the performance of a task, in which many of them are already proficient, can severely affect enthusiasm and motivation. This problem can, in large part, be overcome by the use of a pretest designed to provide a beginning point from which the student can start his or her training. The systematic use of planned instructional outcomes (behavioral objectives) can serve to more effectively motivate students.

The instructor's guide makes no attempt to set down absolute standards defining successful student performance. It will be your responsibility to establish these performance levels for your students. Some performance standards, such as working safety, should probably be set at the 100 percent level. Your professional judgment, and the abilities of your individual students, provide the basis for determining the standard which students must meet before proceeding to another task objective.

PROGRAM APPROACH AND TECHNIQUE

During the exploratory phase of the Construction Program, students are encouraged to explore several job families in construction. As they enter your class, they have made a more refined choice and should now be prepared to develop a number of specific skills.

To accomplish the purpose of this program, a two-fold approach has been taken. The material has been organized into two distinct components -- Instructor's Guide and Student Resource Manuals.

The Instructor's Guide is organized into a task-by-task outlining of suggested activities structured around behavorial objectives.

LESSON PLANNING

Organization and planning are essential to the success of any program. The four-step lesson plan recommended procedure is:

Step 1 Preparation of the Lesson. Applying the principle of Readiness, the instructor should prepare students for the lesson. Information sheets, reading assignments in the text and Student Resource Manual and other introductory techniques can help to prepare the student.

Step 2 Presentation. Applying the principle of Effect, the instructor should present and demonstrate a given process or activity supported by media and selected student involvement. Tell and show how to do the task step-by-step, citing critical check points and special safety requirements.

Step 3 Application of student performance. Applying the principle of Practice, the instructor should permit the students to do the assigned task. Special work sheets, drawings and instructions should be provided the student when necessary.

Step 4 Performance test. Applying the principle of Criteria, referenced testing is used to determine student performance at acceptable levels. Those students who do not meet acceptable performance standards are cycled through Steps 2, 3 and 4 again.

(See Appendix, Sample Lesson Plan)

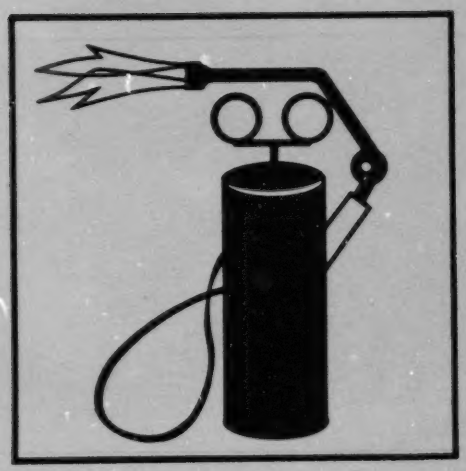
STUDENT RESOURCE MANUAL

The Student Resource Manual is intended to serve as a supplemental text and information manual. It is designed and written for student use and it is structured to compliment the Instructor's Guide. Subjects such as tools and equipment, materials, processes and safety are discussed. A glossary of terms is included in each student manual.

The success or failure of a preparation program can depend on many things. It is hoped that you will encourage student participation in youth organizations which promote scholarship and craftsmanship. VICA organizations have been very successful in motivating and recognizing student accomplishments. If your school does not have a VICA chapter, you can be instrumental in starting one. The rewards to the community, school, and especially the student, can be readily apparent. Other student organizations, such as DECA, may be of interest to students aiming for careers in the wholesaling and retailing of construction products.

Of further value to your program would be the establishment and maintenance of a strong advisory committee. The involvement of members of the community can help to promote your program. A committee of this kind can form a solid bridge between school and community. If your school does not have a construction advisory committee, it is time to start one. The exchange of ideas can benefit both the school and community.

WELDING



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METAL

OVERALL OBJECTIVE: The student will demonstrate ability to weld butt, lap and T-joints in the flat, vertical up and overhead positions and to braze weld mild steel and cast iron using oxyacetylene welding equipment.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and W. A. Bowditch, Modern Welding, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1970.

Modern Arc Welding, (Hobart Trade School: Box EW-200, Troy, Ohio 45373.)

National Safety Council, (425 N. Michigan Avenue, Chicago, Illinois 60611.)

Continued...

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to weld butt, lap and T-joints in the flat, vertical up and overhead positions and to braze weld mild steel and cast iron using oxyacetylene welding equipment.

(Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measurement
  - Whole numbers
  - Decimals
  - Fractions
- Squaring and layout
- Angles and degrees
- Pressures and gauge interpolation

Science

- Metals theory
  - Heating
  - Oxidation
  - Welding
- Gases
  - Oxygen
  - Acetylene
  - Combustion

Communication Skills

- Related safety
  - Using and storing gas welding equipment
  - Burns and first aid
  - Eye protection
- Student Resource Manual
- Manufacturer's literature
- Vocabulary development

METAL

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE I: The student will demonstrate ability to set up and adjust oxyacetylene welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates set up and adjustment of oxyacetylene welding equipment.

A. Identify hazards and safety precautions with oxyacetylene welding equipment.
B. Mount regulators on oxygen and acetylene cylinders and adjust pressure settings.
C. Light torch and adjust to neutral flame, oxidizing flame and carburizing flame.
D. Turn off torch.
E. Bleed pressure from regulators.

II. Students set up and adjust oxyacetylene welding equipment.

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 2: The student will demonstrate ability to carry a puddle using oxyacetylene equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates carrying a puddle.

A. Adjust regulators, light torch and adjust flame to neutral.
B. Form puddle on 1/8" steel plate.
C. Carry puddle across plate.
D. Stress eye protection and safety precautions.

II. Student carries a puddle.

METAL

CONTENT TITLE: Oxyacetylene Welding

SUBJECT OBJECTIVE 3: The student will demonstrate ability to weld beads on flat plate using oxyacetylene equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding beads on flat plate.

A. Light torch and adjust to neutral flame.
B. Deposit beads using filler rod on steel plate.

II. Student welds beads on a flat plate.

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 4: The student will demonstrate ability to weld a butt joint in a flat position with an oxy-acetylene welder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a butt joint in flat position.

A. Prepare metal to be welded.
B. Space and tack weld plates together.
C. Weld plates together.
D. Stress importance of penetration.
E. Discuss undercut.

II. Student welds a butt joint flat.

METAL

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 5: The student will demonstrate ability to weld a lap joint in the flat position with an oxyacetylene welder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a lap joint in flat position.

A. Discuss uses of the lap joint in industry.
B. Discuss advantages and disadvantages of a lap joint.
C. Prepare metal and weld lap joint.
D. Discuss and emphasize importance of torch angle.

II. Student welds a lap joint flat.

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 6: The student will demonstrate ability to weld an inside corner joint (T-joint), using oxyacetylene welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding an inside corner joint (T-joint).

A. Prepare metal and tack together to form a corner joint.
B. Weld inside corner joint.
C. Discuss uses of inside corner joint.
D. Discuss influence of torch angle on the quality of corner joints.

II. Student welds an inside corner joint.

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 7: The student will demonstrate ability to weld butt joint in the vertical-up position using oxyacetylene welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a butt joint in vertical position.

   A. Prepare metal.
   B. Tack weld metal plates together.
   C. Weld vertical-up butt joint.
   D. Demonstrate effects of gravity on the molten puddle.
   E. Demonstrate importance of torch angle and filler rod angle.

II. Student welds butt joint in vertical position.

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 8: The student will demonstrate ability to weld a lap joint in the vertical-up position using oxyacetylene welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a lap joint in vertical position.

   A. Prepare metal.
   B. Tack plates together.
   C. Weld lap joint in vertical position.
   D. Discuss "burn out" of top plate

II. Student welds lap joint vertical.

METAL

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 9: The student will demonstrate ability to weld an inside corner joint in the vertical-up position using oxyacetylene equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding an inside corner joint in the vertical-up position (T-joint).

   A. Discuss and cite examples of insider corner welds used in industry.
   B. Prepare metal.
   C. Tack plates together to form a corner joint.
   D. Weld corner joint in vertical-up position.
   E. Stress importance of proper ventilation on welding inside large containers.

II. Student welds an inside corner joint in vertical-up position.

METAL

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 10: The student will demonstrate ability to weld a butt in overhead position using oxyacetylene equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a butt joint in the overhead position.

   A. Prepare metal.
   B. Tack weld plates together.
   C. Clamp metal in overhead position.
   D. Weld overhead butt joint.
   E. Discuss effects of gravity on the molten puddle.
   F. Discuss importance of welding in the overhead position.

II. Student welds a butt joint in the overhead position.

METAL

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 11: The student will demonstrate ability to weld a lap joint in the overhead position using oxyacetylene equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a lap joint in the overhead position.

A. Prepare metal.
B. Tack weld plates together forming a lap joint.
C. Clamp metal in overhead position.
D. Weld lap joint overhead.
E. Demonstrate importance of torch angle.

II. Student welds a lap joint overhead.

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 12: The student will demonstrate ability to weld an inside corner in the overhead position (T-joint) using oxyacetylene equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding inside corner joint (T-joint) in the overhead position.

A. Prepare metal.
B. Tack plates and place in overhead position.
C. Weld inside corner joint in the overhead position.
D. Demonstrate metal warpage and its prevention.

II. Student welds an inside corner joint in the overhead position.

METAL

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 13: The student will demonstrate ability to braze weld iron using oxyacetylene equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses braze welding of cast iron.

A. Discuss effects of heat on cast iron.
B. Discuss advantages of braze welding cast iron.
C. Discuss preparation of metal.

II. Instructor demonstrates braze welding cast iron.

A. Prepare metal.
B. Grind surfaces.
C. Preheat complete casting.
D. Braze weld cast iron joint.

III. Student braze welds cast iron.

METAL

CONTENT TITLE: Oxyacetylene Welding

SUB OBJECTIVE 14: The student will demonstrate ability to cut with a hand torch using oxyacetylene equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses use of hand torch.

A. Discuss oxidation.
B. Discuss torch angle and speed of travel.
C. Discuss tip size and gas pressure.
D. Discuss safety.

II. Instructor demonstrates cutting with a hand tool.

A. Assemble and adjust hand cutting torch.
B. Cut metal plate in a straight line.
C. Make circle on metal plate and demonstrate a circle cut.

III. Students cut metal with hand torch.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to weld butt, lap and T-joints in the horizontal, vertical up and overhead positions using shielded metal arc welding equipment.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and W. A. Bowditch, Modern Welding, (Goodheart-Wilcox Co., Inc.: 123 Taft Drive, South Holland, Illinois 60473), 1970.

Electrode Pocket Guide, (Airco: Airco Catalog #1318, 150 East 42nd Street, New York, New York 10017).

Modern Arc Welding, (Hobart Trade School: Box EW-200, Troy, Ohio).

New Lessons in Arc Welding, (Lincoln Electric: 22801 Saint Claire Avenue, Cleveland, Ohio 44117), 1957.

Welding Tips I, (Electrode Selection Chart, Form Ed68-1, Lincoln Electric: 22801 Saint Claire Avenue, Cleveland, Ohio 44117).

ACADEMIC RELATED THEORY AND INFORMATION

Math

Electrical measurements
- Amperage
- Voltage

Science

- AC and DC current
- Grounding and arcing
- Welding with electricity
- Bend testing and welds

Communication Skills

- Related safety
  - Care and use of electric welding equipment
  - Eye and body protection
- Manufacturer's literature
- Student Resource Manual

Continued...

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to weld butt, lap and T-joints in the horizontal, vertical up and overhead positions using shielded metal arc welding equipment.

(Continued)

FILMS

The Astrodome, 30 minutes, in color, (American Institute of Steel Construction, Dept. of Educational Services: 101 Park Avenue, New York, New York 10017).

Design for Arc Welded Structures, 15 minutes, in color, (Lincoln Electric: 22801 St. Claire Avenue, Cleveland, Ohio 44117).

Prevention and Control of Distortion in Arc Welding, S-165, 20 minutes, in color, (Lincoln Electric: 22801 St. Claire Avenue, Cleveland, Ohio 44117).

The Shipbuilding Industry, 7 minutes, in color, (Radim Film: 220 West 42nd Street, New York, New York).

METAL

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE 15: The student will demonstrate ability to set up and adjust shielded metal arc welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses shielded metal arc welding.

A. Discuss selection of electrode-types and sizes.
B. Discuss selection of AC or DC power source.
C. Discuss safety in relation to electricity.
D. Discuss protective clothing.
E. Discuss infrared rays and ultraviolet rays.
F. Discuss advantages of shielded metal arc welding.

II. Instructor demonstrates proper set up and adjustments of an arc welding machine.

A. Select electrode.
B. Connect ground cables.
C. Connect leads to arc welding machine.
D. Adjust amperage.

III. Students set up and adjust arc welding machine.

METAL

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE I6: The student will demonstrate ability to run a pad of beads in the flat position with an arc welder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates running beads in the flat position.

A. Strike an arc by tapping and striking and run beads on flat plate.
B. Tie beads together in a flat plate.
C. Clean the weld. (Stress safety.)

II. Student welds beads on pad in the flat position.

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE I7: The student will demonstrate ability to weld a T-joint in the flat position with an arc welder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a T-joint in the flat position.

A. Prepare metal.
B. Tack weld plates, to form a T-joint.
C. Weld T-joint.

II. Student welds T-joint in the flat position.

METAL

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE 18: The student will demonstrate ability to weld a multi-pass V-butt joint in the flat position with an arc welder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a V-butt joint flat.

A. Bevel plates and prepare plates.
B. Space and tack plates together.
C. Adjust amperage and weld root pass.
D. Adjust amperage and weld additional beads to fill V.

II. Student welds V-butt joint flat.

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE 19: The student will demonstrate ability to run a pad of beads in the horizontal position with an arc welder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding beads on a pad in the horizontal position.

A. Prepare metal.
B. Tack plate in horizontal position.
C. Run horizontal beads and tie beads together forming a pad.
D. Stress importance of electrode angle in counteracting sagging of the bead.

II. Student welds beads on a pad in the horizontal position.

METAL

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE 20: The student will demonstrate ability to weld a V-butt joint in the horizontal position with an arc welder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a V-butt joint in the horizontal position.

   A. Prepare metal for a V-butt joint.
   B. Tack plates together in horizontal position.
   C. Weld root pass.
   D. Weld additional beads on either side of V to fill.

II. Student welds a horizontal V-butt joint.

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE 21: The student will demonstrate ability to weld beads on a pad in the vertical position, welding uphill with arc welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding beads uphill.

   A. Prepare metal.
   B. Adjust machine for proper electrode size.
   C. Discuss advantages of an uphill bead.
   D. Weld beads on a vertical pad, welding uphill.

II. Student welds vertical beads welding uphill.

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE 22: The student will demonstrate ability to weld a T-joint in the vertical position, welding uphill with arc welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a vertical T-joint.

A. Prepare metal.
B. Weld multi-pass vertical T-joint welding uphill.
C. Demonstrate an uphill weave on a vertical T-joint.

II. Students weld vertical T-joint welding uphill.

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE 23: The student will demonstrate ability to weld a V-butt joint in the vertical position with an arc welder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding vertical V-butt joint.

A. Demonstrate an uphill root pass.
B. Demonstrate a downhill root pass.
C. Demonstrate a stringer bead cap.
D. Demonstrate a weave bead cap.

II. Student welds a vertical V-butt joint.

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE 24: The student will demonstrate ability to weld beads on pad in the overhead position using arc welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates running beads on a pad in the overhead position.

   A. Prepare metal.
   B. Tack plate in overhead position.
   C. Weld beads in a pad in the overhead position.

II. Student welds beads in the overhead position.

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE 25: The student will demonstrate ability to weld T-joint in the overhead position using arc welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding an overhead T-joint.

   A. Prepare metal.
   B. Tack plates together to form a T-joint.
   C. Weld overhead T-joint using a weaving motion.

II. Student welds an overhead T-joint.

METAL

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE 26: The student will demonstrate ability to weld a V-butt joint in the overhead position using arc welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding V-butt joints overhead.

A. Bevel and prepare metal plates.
B. Adjust machine and run root pass.
C. Weld filler beads in V-butt joint.
D. Discuss importance of proper metal preparation.

II. Students weld a V-butt joint overhead.

METALS

CONTENT TITLE: Shielded Metal Arc Welding

SUB OBJECTIVE 27: The student will demonstrate ability to complete a guided bend test using arc welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the A.S.M.E. guided bend test.

   A. Discuss how to prepare plates for testing.
   B. Discuss effects of cooling metal too fast.
   C. Discuss coupon cutting procedure.

II. Instructor demonstrates running a guided bend test.

   A. Prepare plates for testing.
   B. Weld test specimens.
   C. Cut coupons from best specimens.
   D. Bend test specimens, both root and face bend, for flat, vertical and overhead position.

III. Students take guided bend test, testing overhead and vertical uphill joints.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to weld a V-butt and T-weld in the flat, vertical up and overhead positions and a butt and T-joint on light gauge metal using metal inert gas (MIG) welding equipment.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and W. A. Bowditch, Modern Welding, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1970.

Micro-Wire Welding, (Hobart Brothers Technical Center: Box EW-300, Troy, Ohio).

Modern Arc Welding, (Hobart Trade School: Box EW-200, Troy, Ohio).

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Properties of inert gases

Communication Skills

- Related safety
  - Care and use of MIG welding equipment
- Manufacturer's literature
- Student Resource Manual

METAL

CONTENT TITLE: Metal Inert Gas Welding

SUB OBJECTIVE 28: The student will demonstrate ability to set up and adjust MIG welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses set up and adjustment of equipment.

A. Discuss proper use of safety equipment and safety clothing.
B. Discuss different type of wire (welding) and gases.
C. Discuss AC and DC power supply, wire speed control and settings.
D. Discuss power source.
E. Discuss metering to obtain the correct gas flow.
F. Discuss wire speed and heats.
G. Discuss proper care of gun.

II. Instructor demonstrates set up of equipment.

A. Connect mix gas to regulator.
B. Set heat range for proper heat and adjust wire speed for gauge of metal.
C. Ensure that gun does not have slag around contact tip.

II. Students set up equipment.

CONTENT TITLE: Metal Inert Gas Welding

SUB OBJECTIVE 29: The student will demonstrate ability to weld beads in the flat position with MIG equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding beads in the flat position.

A. Cut coupon 4" x 6" and place flat on table.
B. Hold gun so that there will be an even amount of gas over the bead.
C. Strike arc and hold gun about 1/2" from metal.
D. Run bead across plate in a straight line.
E. Run second bead about half way on top of first bead, tying bead together; fill plate with beads.

II. Student welds beads in flat position.

CONTENT TITLE: Metal Inert Gas Welding

SUB OBJECTIVE 30: The student will demonstrate ability to weld beads in the vertical uphill position, using MIG equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding beads in a vertical uphill position.

A. Cut coupon and place in vertical position.
B. Strike arc, holding gun 1/2" away from metal.
C. Run first bead downhill on edge of metal.
D. Run succeeding beads uphill, attaching beads to previous bead strings.
E. Fill plate with beads.

II. Student welds beads in a vertical uphill position.

METAL

CONTENT TITLE: Metal Inert Gas Welding

SUB OBJECTIVE 31: The student will demonstrate ability to MIG weld a T-joint in the flat position.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a flat joint.

A. Cut and prepare two pieces of metal.
B. Place one piece flat on table and stand other piece up on edge in middle of base plate; tack on each end.
C. Run first bead in bottom of T; apply the same amount of metal on both plates (always maintaining a 45° angle with weld deposit).
D. Fill T, tying beads together to form a 45° angle.

II. Student welds a flat joint.

CONTENT TITLE: Metal Inert Gas Welding

SUB OBJECTIVE 32: The student will demonstrate ability to MIG weld a T-joint in the overhead position.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding T-welds in the overhead position.

A. Cut and prepare two pieces of metal.
B. Place one piece flat on table and stand other piece up on edge in middle of base plate. Tack weld on each end.
C. Position overhead.
D. Run first bead in bottom of T; apply the same amount of metal on both plates (always maintaining a 45° angle with weld deposit).
E. Fill T, tying beads together forming a 45° angle.

II. Student welds a T-weld in the overhead position.

METAL

CONTENT TITLE: Metal Inert Gas Welding

SUB OBJECTIVE 33: The student will demonstrate ability to MIG weld a T-joint in the vertical uphill position.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a T-joint, vertical-up.

A. Cut and prepare two pieces of metal for T-weld and place in vertical position.
B. Strike arc at bottom of T and move upward with a slight weave, pausing at end of each weave.
C. Fill T with even amount of metal on each plate.

II. Student welds a vertical uphill T-weld.

CONTENT TITLE: Metal Inert Gas Welding

SUB OBJECTIVE 34: The student will demonstrate ability to MIG weld a V-butt joint in the flat position.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a flat V-butt joint.

A. Cut and prepare metal for V-butt weld.
B. Tack weld on each end with a 1/16" to 3/32" opening.
C. Strike arc and run first bead into open V; check for good penetration.
D. Fill up V with beads.

II Student welds a flat V-butt joint.

METAL

CONTENT TITLE: Metal Inert Gas Welding

SUB OBJECTIVE 35: The student will demonstrate ability to MIG weld a V-butt joint in the vertical position.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a vertical up V-butt joint.

A. Cut and prepare metal for V-butt weld, then place in vertical position.
B. Strike arc at top of V and run first bead downhill; check for good penetration.
C. Fill up V with uphill beads, tying subsequent beads to previously prepared beads.

II. Student welds a vertical up V-butt joint.

CONTENT TITLE: Metal Inert Gas Welding

SUB OBJECTIVE 36: The student will demonstrate ability to MIG weld a T-joint on light gauge metal.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a T-joint on light metal.

A. Cut and prepare two pieces of light gauge metal; tack weld for T-joint weld.
B. Strike arc; put same amount of weld on both pieces of metal. (Bottom T will take more heat than the piece on the edge.)

II. Student welds a T-joint on light gauge metal.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to weld square butt, lap and T-joints in the flat, vertical up and overhead positions on aluminum and stainless steel using tungsten inert gas (TIG) welding equipment.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and W. A. Bowditch, Modern Welding, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1970.

Griffin, Ivan, H., and Edward M. Roden, Basic TIG and MIG Welding, (DelMar Publishers Inc.: P. O. Box 5087, Albany, New York 12205), 1971.

Welder's Training Manual, (Kaiser Aluminum: 214 North Cherry Street, Dotham, Alabama 36301), 2nd ed., 1965.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review math requirements for job entry or post-secondary training

Science

- Properties of aluminum, stainless steel and nickel
- Argon gases
- Uses of tungsten
- Review science requirements for job entry or post-secondary training.

Communication Skills

- Related safety - care and use of TIG welding equipment
- Review career and training opportunities
  - Job placement
  - Post-secondary training
  - Apprenticeship
  - Armed services

Continued...

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to weld square butt, lap and T-joints in the flat, vertical up and overhead positions on aluminum and stainless steel using tungsten inert gas (TIG) welding equipment.

(Continued)

FILMS

Aluminum on the Skyline, #s-161, 28 minutes, in color, (Aluminum Co. of America: 1501 Alcoa Building, Pittsburgh, Pennsylvania 15219).

Welding Advances with Aluminum, #s-987, 28 minutes, in color, (Aluminum Co. of America: 1501 Alcoa Building, Pittsburgh, Pennsylvania 15219).

METAL

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 37: The student will demonstrate ability to set up and adjust TIG welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates set up of equipment.

A. Connect argon.
B. Select correct size electrode for job.
C. Turn on water supply.

II. Student sets up equipment.

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 38: The student will demonstrate ability to form and carry a puddle on aluminum plate using TIG equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates forming and carrying a puddle on aluminum.

A. Adjust machine.
B. Strike arc and form a puddle.
C. Carry puddle across plate, eliminating crater at end of puddle.

II. Student forms and carries a puddle on aluminum.

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 39: The student will demonstrate ability to form flat beads on aluminum using TIG welding equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates running flat beads on aluminum plate.

A. Strike arc on plate to form a puddle.
B. Dip rod into puddle to add metal.
C. Continue process and tie beads together.

II. Student runs flat beads on an aluminum plate.

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 40: The student will demonstrate ability to TIG weld a square butt joint in the flat position on aluminum.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a square butt joint.

A. Cut and prepare two pieces of aluminum.
B. Space aluminum apart the thickness of the rod and tack weld on each end.
C. Strike arc and form puddle.
D. Add rod and carry across plate.

II. Student welds a square butt joint.

METAL

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 41: The student will demonstrate ability to TIG weld a specific T-joint in the flat position on aluminum.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a flat T-joint.

A. Cut and prepare two pieces of aluminum.
B. Place one plate on edge and position in center of other plate.
C. Tack weld each end.
D. Strike arc and form puddle; add rod and carry across joint.

II. Student welds a flat T-joint.

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 42: The student will demonstrate ability to TIG weld a lap joint in the flat position on aluminum.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a lap joint in the flat position.

A. Cut and prepare two pieces of aluminum.
B. Place one plate on top of base plate leaving about 1/2 exposed; tack weld on each end.
C. Check that top plate is flat against base plate
D. Weld lap joint together (base plate will take more heat than top plate).

II. Student welds flat lap joint.

METAL

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 43: The student will demonstrate ability to TIG weld an overhead square butt joint on aluminum.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding an overhead square butt joint.

A. Cut and prepare two pieces of aluminum.
B. Place both plates flat on table and space them apart the thickness of weld rod; tack on both ends.
C. Place plates in overhead position.
D. Strike arc, form puddle, add rod and carry across plate.

II. Student welds an overhead square butt joint.

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 44: The student will demonstrate ability to TIG weld an overhead T-joint on aluminum.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding an overhead T-joint.

A. Cut and prepare two pieces of aluminum.
B. Place one piece of aluminum on table and stand the other piece on edge; tack weld on each side.
C. Place plates in overhead position.
D. Strike arc to form puddle; add rod to puddle.
E. Carry puddle along seam.

II. Student does an overhead T-joint weld.

METAL

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 45: The student will demonstrate ability to TIG weld an overhead lap joint on aluminum.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding an overhead lap joint.

A. Cut and prepare two pieces of aluminum.
B. Place one plate on top of base plate leaving about 1/2 exposed; tack weld on each end.
C. Check that top plate is flat against base plate.
D. Weld lap joint together (base plate will take more heat than top plate).

II. Student welds an overhead lap joint.

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 46: The student will demonstrate ability to TIG weld a square butt joint in the vertical up position on aluminum.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a vertical up square butt joint.

A. Cut and prepare two pieces of aluminum.
B. Place plates on table leaving the thickness of rod between the plate.
C. Tack weld on each end.
D. Place in vertical position and weld uphill (from bottom to top).

II. Student welds a square butt joint, vertical up.

METAL

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 47: The student will demonstrate ability to TIG weld a lap joint in the vertical uphill position on aluminum.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a vertical joint.

A. Cut and prepare two pieces of aluminum plate.
B. Place one plate on top of base plate leaving about 1/2 exposed; tack weld on each end.
C. Check that top plate is flat against base plate, then place plate in a vertical position.
D. Weld lap joints together (base plate will take more heat than top plate).

II. Student welds vertical up lap joints.

METAL

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 48: The student will demonstrate ability to TIG weld a square flat butt joint on stainless steel.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses principles of TIG welding stainless steel.

   A. Discuss reasons for preferring DC straight polarity to AC for stainless steel welding.
   B. Discuss types of stainless steel rod and material.
   C. Discuss flowmeter and gases.
   D. Discuss safety and protective clothing.
   E. Discuss preparing electrode for stainless steel welding.

II. Instructor demonstrates welding a flat butt joint on stainless steel.

   A. Cut and prepare two pieces of stainless steel.
   B. Space stainless apart the thickness of filler rod and tack weld on each end.
   C. Strike arc and form puddle.
   D. Add rod to puddle and weld across plates.

III. Student welds a square flat butt joint on stainless steel.

METAL

CONTENT TITLE: Tungsten Inert Gas Welding

SUB OBJECTIVE 49: The student will demonstrate ability to TIG weld a T-joint in the flat position.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a flat T-joint on stainless steel.

   A. Cut and prepare two pieces of stainless.
   B. Place one plate on edge, put in center of other plate and tack weld on each end.
   C. Strike arc and form puddle. (Base plate will carry more heat than one on edge.)
   D. Add rod and carry across joint.

II. Student welds a flat T-joint on stainless steel.

SHEET METAL

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to construct working drawings of, and patterns for square or rectangular, cylindrical and conical fabrications in sheet metal.

SOURCES OF INFORMATION

Bruce, Leroy F. and Leo A. Meyer, Sheet Metal Shop Practice, (AmericanTechnical Society: 848 East 58th Street, Chicago, Illinois 60637).

Kaberlein, Joseph J., Air Conditioning Metal Layout, 3rd Edition, (Benziger Bruce & Glencoe, Inc.: 8701 Wilshire Boulevard, Beverly Hills, California 90211), 1973.

Bureau of Naval Personnel, Navy Training Course - Blueprint Reading and Sketching, NAVPERS 10077-B. (Order from Government Printing Office, Document No. D208.11: B62/968).

Bureau of Naval Personnel, Navy Training Course - Shipfitter 3 & 2, NAVPERS 10595-B. (Order from Government Printing Office, Document No. D208.11: Sh616/970).

Suggested Job Sheets: Sheet Metal Series, (DelMar Publishers Inc.: P.O. Box 5087, Albany, New York 12205).

Suggested Unit Course in Measurement and Layout: Sheet Metal Series, (DelMar Publishers Inc.: P. O. Box 5087, Albany, New York 12205).

Continued...

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to construct working drawings of, and patterns for square or rectangular, cylindrical and conical fabrications in sheet metal.

(Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Multiplication
- Division
- Addition
- Subtraction
- Whole numbers
- Fractions
- Decimals
- Scale measurements
- Dividing circles and lines
- Radii
- Circumference
- Pi
- Triangles

Communication Skills

- Blueprint reading and interpretation
- Technical literature
- Working drawings
- Student Resource Manual
- Related safety information

METAL

CONTENT TITLE: Blueprint Reading and Sketching

SUB OBJECTIVE I: The student will demonstrate ability to construct a working drawing of a 4" x 6" x 1" drip pan.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates constructing a working drawing of a drip pan.

   A. Explain the proper use of blueprint lines.
   B. Identify symbols.
   C. Explain the location of instructions on a blueprint.
   D. Demonstrate the proper use of the drawing tools such as T squares, scales, compasses, pencils, curves, protractors and triangles.

II. Students construct a working drawing of a drip pan.

CONTENT TITLE: Methods of Layout

SUB OBJECTIVE 2: The student will demonstrate ability to construct layout of a cylinder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out a cylinder.

   A. Identify method of layout (parallel line method).
   B. Explain how to find measurements of layout (math problem on circumference of cylinder).
   C. Calculate allowances for seams.
   D. Identify tools to make layout.

II. Students layout a cylinder on drawing paper.

METAL

CONTENT TITLE: Methods of Layout

SUB OBJECTIVE 3: The student will demonstrate ability to construct layout of frustrum of a cone.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out a frustrum of a cone.

A. Define frustrum.
B. Identify method of layout of a frustrum of a cone (radial line method).
C. Layout baseline, vertical centerline, slant lines, half circle and stretchout.

II. Students layout frustrum of a cone on drawing paper.

CONTENT TITLE: Methods of Layout

SUB OBJECTIVE 4: The student will demonstrate ability to construct layout of a square to round transition.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates layout out a square-to-round transition.

A. Identify method of layout (triangulization method).
B. Emphasize proper procedure, step by step.
C. Identify tools to make layout.

II. Students layout square to round transition.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to perform basic sheet metal operations in the preparation of square and round pipes, with a variety of flange configurations and square and round drip pans.

SOURCES OF INFORMATION

Bruce, Leroy F. and Leo A. Meyer, Sheet Metal Shop Practice, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637).

Suggested Job Sheets: Sheet Metal Series, (DelMar Publishers, Inc.: P.O. Box 5087, Albany, New York 12205).

Suggested Unit Course in Machine Processes: Sheet Metal Series, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York 12205).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measure, square and layout
- Degrees and angles

Communication Skills

- Drawing to scale
- Blueprint interpretation and symbols

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 5: The student will demonstrate ability to construct pattern and fabricate a one piece supply box.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the layout and fabrication of a one piece supply box.

   A. Identify method (parallel line method).
   B. Layout box on chalkboard.
   C. Stress accuracy and neatness.

II. Student develops pattern and fabricates a one piece supply box.

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 6: The student will demonstrate ability to construct pattern and fabricate a round pipe with 90° flange.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a round pipe with 90° flange.

   A. Identify method of layout (parallel line method).
   B. Layout round pipe with 90° flange on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop pattern and fabricate a round pipe with 90° flange.

METAL

CONTENT TITLE: Sheet metal Pattern Development and Fabrication

SUB OBJECTIVE 7: The student will demonstrate ability to construct pattern and fabricate a square pipe with 45° flange.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a square pipe with 45° flange.

   A. Identify method of layout (parallel line method).
   B. Layout square pipe with 45° flange on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop pattern and fabricate square pipe with 45° flange.

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 8: The student will demonstrate ability to construct pattern and fabricate a round pipe with 34° flange.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a round pipe with a 34° flange.

   A. Identify method of layout (parallel line method).
   B. Layout round with 34° flange on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a pipe with a 34° flange.

METAL

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 9: The student will demonstrate ability to construct pattern and fabricate a round pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a round pipe.

A. Identify method of layout (radial and parallel method).
B. Layout round pan on chalkboard.
C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a round pipe.

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 10: The student will demonstrate ability to construct pattern and fabricate a round pipe with double angle flange.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a round pipe with double angle flange.

A. Identify method of layout (parallel line method).
B. Layout round pipe with a double angle flange on chalkboard.
C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a round pipe with a double angle flange.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to fabricate all the fundamental ductwork commonly used in air conditioning and heating installations in both square and round pipe configurations.

SOURCES OF INFORMATION

Anderson, Edwin P., Sheet Metal Pattern Layouts, (Theodore Audel & Co., Division of Howard W.Sams & Co.: 4300 West 62nd Street, Indianapolis, Indiana), 1965.

Kaberlein, Joseph J., Air Conditioning Metal Layout, 3rd Edition, (Benziger Bruce & Glencoe, Inc.: 8701 Wilshire Boulevard, Beverly Hills, California 90211), 1973.

Low Velocity Duct Construction Standards, (Sheet Metal and Air Conditioning Contractor's National Association, Inc.: P. O. Box 3506, Washington, D.C. 20007).

Suggested Job Sheets: Sheet Metal Series, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York 12205).

Suggested Unit Course in Machine Processes: Sheet Metal Series, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York 12205).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Degrees and angles
- Measuring for accuracy
- Gauging of metals

Science

- Conductivity
- Insulation

Communication Skills

- Blueprint interpretation
- Technical literature
- Related safety information

METAL

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE I1: The student will demonstrate ability to construct pattern and fabricate a 90° square elbow with round heel.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a 90° square elbow with a round heel.

   A. Identify method of layout (parallel and radial line method).
   B. Layout a 90° square elbow with round heel on chalk-board.
   C. Stress accuracy and neatne.

II. Students develop a pattern and fabricate a 90° square elbow with a round heel.

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE I2: The student will demonstrate ability to construct pattern and fabricate a 90° square elbow with round heel and throat.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a 90° square elbow with a round heel and throat.

   A. Identify method of layout (parallel and radial line method).
   B. Layout a 90° square elbow with a round heel and throat.
   C. Stress accuracy and neatness.

II. Students develop pattern and fabricate a 90° square elbow with round heel and throat.

METAL

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 13: The student will demonstrate ability to construct pattern and fabricate a 90° reducing elbow.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a 90° reducing elbow.

   A. Identify method of layout (parallel and radial line method).
   B. Layout a 90° reducing elbow on chalkboard.
   C. Stress accuracy and neatness.

II. Student develops pattern and fabricates a 90° reducing elbow.

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 14: The student will demonstrate ability to construct pattern and fabricate an offset elbow with round heel and throat.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating an offset elbow with a round heel and throat.

   A. Identify method of layout (parallel and radial line method).
   B. Layout an offset elbow on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate an offset elbow with round heel and throat.

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE I5: The student will demonstrate ability to construct pattern and fabricate a square to round fitting.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a square to round fitting.

   A. Identify method of layout (triangulization).
   B. Layout a square to round fitting on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a square to round fitting.

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE I6: The student will demonstrate ability to construct pattern and fabricate a rectangular to round fitting.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a rectangular to round fitting.

   A. Identify method of layout (triangulization).
   B. Layout a rectangular to round fitting on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a rectangular to round fitting.

METAL

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 17: The student will demonstrate ability to construct pattern and fabricate a two-piece 45° cylindrical elbow.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a two-piece 45° cylindrical elbow.

   A. Identify method of layout (parallel line method).
   B. Layout a two-piece 45° cylindrical elbow on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a two-piece 45° cylindrical elbow.

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 18: The student will demonstrate abiliity to construct pattern and fabricate a 90° cylindrical T-joint.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a 90° cylindrical T-joint.

   A. Identify method of layout (parallel line method).
   B. Layout a 90° cylindrical T-joint on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a 90° cylindrical T-joint.

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 19: The student will demonstrate ability to construct pattern and fabricate a 45° cylindrical T-joint.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a 45° cylindrical T-joint.

   A. Identify method of layout (parallel line method).
   B. Layout 45° cylindrical T-joint on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a 45° cylindrical elbow.

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 20: The student will demonstrate ability to construct pattern and fabricate a five-piece 90° cylindrical elbow.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a five-piece 90° cylindrical elbow.

   A. Identify method of layout (parallel line method).
   B. Layout a five-piece 90° cylindrical elbow on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a five-piece 90° cylindrical elbow.

METAL

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 21: The student will demonstrate ability to construct pattern and fabricate a 60° cylindrical Y-joint.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a 60° cylindrical Y-joint.

   A. Identify method of layout (parallel line method).
   B. Layout a 60° cylindrical Y-joint on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a 60° cylindrical Y-joint.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to fabricate a ventilator top (or rectangular hopper) and to miter a 90° ogee gutter.

SOURCES OF INFORMATION

Anderson, Edwin P., Sheet Metal Pattern Layouts, (Theodore Audel & Co., Division of Howard W. Sams & Co.: 4300 West 62nd Street, Indianapolis, Indiana), 1965.

Kaberlein, Joseph J., Air Conditioning Metal Layout, 3rd Edition, (Benziger Bruce & Glencoe, Inc.: 8701 Wilshire Boulevard, Beverly Hills, California 90211), 1973.

Suggested Job Sheets: Sheet Metal Series, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York 12205).

Suggested Unit Course in Machine Processes: Sheet Metal Series, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York 12205).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Involutes for patterns
- Measuring and layout

Communication Skills

- Engineering specs
- Working drawings

METAL

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 22: The student will demonstrate ability to construct a pattern and fabricate a ventilator top.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a rectangular hopper.

   A. Identify method of layout (radial, parallel and triangulation method).
   B. Layout rectangular hopper and chalkboard.
   C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a rectangular hopper.

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 23: The student will demonstrate ability to construct pattern and fabricate a 90° ogee guttermiter.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a 90° ogee guttermiter.

   A. Identify method of layout (parallel line and radial line method).
   B. Layout 90° ogee guttermiter on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop pattern and fabricate a 90° ogee gutter.

METAL

CONTENT TITLE: Sheet Metal Pattern Development and Fabrication

SUB OBJECTIVE 24: The student will demonstrate ability to construct pattern and fabricate a 30° ogee guttermiter.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating a 30° ogee guttermiter.

   A. Identify method of layout (parallel and radial line method).
   B. Layout a 30° ogee guttermiter on chalkboard.
   C. Stress accuracy and neatness.

II. Students develop a pattern and fabricate a 30° ogee guttermiter.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to safely set up and operate arc, TIG and oxyacetylene welding equipment to cut and fasten sheet metal.

SOURCES OF INFORMATION

Graham, Frank D. and Edwin P. Anderson, Sheet Metal Worker's Handybook, (Theodore Audel & Co., Division of Howard W. Sams & Co., Inc.: 4300 West 62nd Street, Indianapolis, Indiana), 1966.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Properties of gases
- Oxidation
- Heat and metals
- Electric welding
- Brazing and fluxes

Communication Skills

- Related safety information
  - Explosive gases
  - Eye protection
  - Clothing
- Manufacturer's technical information

METAL

CONTENT TITLE: Sheet Metal Welding

SUB OBJECTIVE 25: The student will demonstrate ability to safely set up, adjust, operate and shut down an oxyacetylene welding torch in sheet metal cutting operations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates set up and adjustment of oxyacetylene torches.

A. Discuss safety.
B. Identify parts of oxyacetylene equipment--regulators, tanks, jets, etc.
C. Set oxygen pressure.
D. Set acetylene pressure.
E. Demonstrate proper flame adjustment--carbonizing flames, neutral flames and oxydizing flames.
F. Demonstrate shut down procedures; shut off flame.
G. Bleed pressure off acetylene regulator.
H. Bleed pressure off oxygen regulator.
I. Demonstrate cutting procedures.

II. Students set up, adjust and shut down an oxyacetylene torch.

METAL

CONTENT TITLE: Sheet Metal Welding

SUB OBJECTIVE 26: The student will demonstrate ability to weld sheet metal using an oxyacetylene welding torch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding sheet metal with oxyacetylene welding equipment.

   A. Identify safety precautions.
   B. Identify type of sheet metal to be used.
   C. Identify types of welding rods to be used.
   D. Name size of welding tip to be used.
   E. Set pressure on regulator.
   F. Light torch and adjust for neutral flame.
   G. Weld sheet metal.

II. Students weld sheet metal with an oxyacetylene welding torch.

METAL

CONTENT TITLE: Sheet Metal Welding

SUB OBJECTIVE 27: The student will demonstrate ability to braze sheet metal using an oxyacetylene welding torch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates brazing of sheet metal with an oxyacetylene welding torch.

   A. Identify safety precautions.
   B. Identify type of sheet metal to be brazed.
   C. Identify type of brazing rod to be used.
   D. Name size of tip to be used.
   E. Identify flux.
   F. Set pressure on regulators.
   G. Light torch and set pressure.
   H. Braze sheet metal.

II. Students braze sheet metal with an oxyacetylene welding torch.

METAL

CONTENT TITLE: Sheet Metal Welding

SUB OBJECTIVE 28: The student will demonstrate ability to prepare butt welds on sheet metal using an electric arc welder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding a butt weld in flat position with an arc welder.

   A. Identify safety precautions.
   B. Identify tools and equipment.
   C. Identify type of sheet metal.
   D. Identify type of electrode.
   E. Set machine for proper current.
   F. Ground metal to be welded.
   G. Use proper clothing.
   H. Weld sheet metal.

II. Students make a butt weld with an arc welder.

METAL

CONTENT TITLE: Sheet Metal Welding

SUB OBJECTIVE 29: The student will demonstrate ability to butt weld sheet metal using a heli-arc TIG welding machine.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates welding with the TIG welding machine in flat position.

   A. Identify safety precautions.
   B. Identify tools and equipment.
   C. Identify type of sheet metal.
   D. Identify type of welding rod.
   E. Set machine for proper current and polarity.
   F. Set gas pressure on regulators.
   G. Ground material.
   H. Weld sheet metal.

II. Students make butt weld with TIG welding machine.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to neatly fasten sheet metals by riveting, screwing, soldering, welding or hemming (or a combination of the above) and to prepare a wired edge.

SOURCES OF INFORMATION

Bruce, Leroy F. and Leo A. Meyer, Sheet Metal Shop Practice (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637).

Kaberlein, Joseph J., Air Conditioning Metal Layout, 3rd Edition, (Benziger Bruce & Glencoe, Inc.: 8701 Wilshire Boulevard, Beverly Hills, California 90211), 1973.

Low Velocity Duct Construction Standards, (Sheet Metal and Air Conditioning Contractor's National Association, Inc.: P. O. Box 3506, Washington, D.C. 20007).

Bureau of Naval Personnel, Navy Training Course - Shipfitter 3 & 2, NAVPERS 10595-B. (Order from Government Printing Office, Document No. D208.11: Sh616/970).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring and layout

Science

- Basic metalurgy
- Soldering and flux theory
- Welding theory

Communication Skills

- Technical literature

METAL

CONTENT TITLE: Fastening Methods

SUB OBJECTIVE 30: The student will demonstrate ability to fasten material by use of tinners rivets.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing, upsetting and heading tinners rivets.

   A. Identify tools used for riveting, such as rivet sets, riveting hammers and hand punches.
   B. Compare size of rivets to thickness of material.
   C. Stress the importance of drawing.
   D. Demonstrate upsetting rivets.
   E. Demonstrate heading rivets.

II. Students rivet two pieces of metal together.

CONTENT TITLE: Fastening Methods

SUB OBJECTIVE 31: The student will demonstrate ability to fasten material by the use of pop rivets.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates using the pop rivet tool.

   A. Identify the various types of pop rivet tools.
   B. Stress the proper use of tool to prevent damaging it.
   C. Explain the selecting of rivet sizes to match thickness of material being joined.

II. Students rivet two pieces of material together.

CONTENT TITLE: Fastening Methods

SUB OBJECTIVE 32: The student will demonstrate ability to fasten material by use of sheet metal screws.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fastening two pieces of metal together by use of sheet metal screws.

   A. Discuss screw sizes.
   B. Stress importance of using two hole sizes.
   C. Identify methods of placing screws in metal.

II. Students fasten two pieces of metal with sheet metal screws.

CONTENT TITLE: Fastening Methods

SUB OBJECTIVE 33: The student will demonstrate ability to fasten material by use of soft solder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates soldering all types of sheet metal.

   A. Identify types of flux to be used on each type of sheet metal.
   B. Stress safety of using flux.
   C. Identify types of soldering furnaces.
   D. Identify types of soldering irons.

II. Students solder various types of sheet metal.

METAL

CONTENT TITLE: Fastening Methods

SUB OBJECTIVE 34: The student will demonstrate ability to fasten material by spot welding.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates spot welding sheet metal.

A. Set heat range control.
B. Set timer control.
C. Turn on water coolant.
D. Turn on power.
E. Spot weld material.
F. Stress safety.

II. Students spot weld sheet metal.

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 35: The student will demonstrate ability to construct a single hem.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating a single hem.

A. Cut sheet metal.
B Mark metal.
C. Bend metal.
D. Stress safety.

II. Students fabricate a single hem.

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 36: The student will demonstrate ability to construct a double hem.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating a double hem.

A. Cut sheet metal.
B. Mark metal.
C. Bend metal.
D. Stress safety.

II. Student fabricates a double hem.

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 37: The student will demonstrate ability to construct a wired edge.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating a wired edge.

A. Measure, mark and cut sheet metal.
B. Measure and cut wire.
C. Mark metal for bends.
D. Bend metal and form around wire.
E. Stress safety.

II. Students fabricate a wired edge.

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 38: The student will demonstrate ability to construct a single lap seam.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating of a single lap seam.

A. Cut sheet metal (two pieces).
B. Mark sheet metal.
C. Lap sheet metal.
D. Demonstrate soldering, riveting and spot welding lap seams.
E. Stress safety.

II. Students construct a single lap seam by riveting, soldering and spot welding.

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 39: The student will demonstrate ability to construct a double lap seam.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating a double lap seam.

A. Cut sheet metal.
B. Mark sheet metal.
C. Bend sheet metal.
D. Groove sheet metal.
E. Lock seam.
F. Stress safety.

II. Students fabricate a double lap seam.

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 40: The student will demonstrate ability to construct a standing seam (air duct connection).

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating a standing seam.

A. Cut metal.
B. Mark metal.
C. Bend metal.
D. Lock seam.
E. Stress safety.

II. Students fabricate a standing seam.

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 41: The student will demonstrate ability to construct a Pittsburgh lock seam.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating a Pittsburgh lock seam.

A. Cut sheet metal (4 pieces).
B. Mark metal.
C. Form metal with cornice brake and a Pittsburgh lock machine.
D. Stress safety.

II. Students fabricate a Pittsburgh lock seam.

METAL

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 42: The student will demonstrate ability to construct a grooved seam.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating a grooved seam.

A. Cut sheet metal.
B. Mark sheet metal.
C. Form seam with snap lock machine.
D. Stress safety.

II. Students fabricate a grooved seam.

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 43: The student will demonstrate ability to construct a drive clip (air duct connection).

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating a drive clip.

A. Cut sheet metal (3 pieces).
B. Mark metal.
C. Bend metal.
D. Assemble drive clip.
E. Stress safety.

II. Students fabricate a drive clip.

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 44: The student will demonstrate ability to construct an s-slip (air duct connection).

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating an s-slip.

A. Cut metal.
B. Mark metal.
C. Form s-slip.
D. Stress safety.

II. Students fabricate s-slip.

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 45: The student will demonstrate ability to construct an angle slip s-cleat (air duct connection).

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating an angle slip s-cleat.

A. Cut metal.
B. Mark metal.
C. Form angle slip s-cleat.
D. Stress safety.

II. Students fabricate an angle slip s-cleat.

METAL

CONTENT TITLE: Seams and Joints

SUB OBJECTIVE 46: The student will demonstrate ability to construct a government clip (air duct connection).

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating a government clip.

   A. Cut metal.
   B. Mark metal.
   C. Form clip.
   D. Stress safety.

II. Students fabricate a government clip.

PLUMBING

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to cut and fasten, in a variety of configurations, cast iron soil pipe and to fasten cast iron soil pipe to a variety of other types of pipe.

SOURCES OF INFORMATION

Department of the Army, Plumbing and Pipefitting, TM5-551K, 1971. (Order from Government Printing Office, Document No. D101.11: 5-551K).

Slater, Harry, Plumbing I and II, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York 12205), 1958 (2 books)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material sizing
- Torque pounds
- Degrees and angles

Communication Skills

- Related safety
  - Metal working
  - Molten lead
  - Various cements
  - Lifting and moving
  - Hazardous tools and equipment
- Manufacturer's literature

METAL

CONTENT TITLE: Cast Iron Soil Pipe Operations

SUB OBJECTIVE I: The student will demonstrate ability to accurately measure and cut cast iron soil pipe by hand.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses cast iron soil pipe operations.

A. Discuss types and uses of cast iron soil pipe.
B. Discuss cutting operations.

II. Instructor demonstrates cutting cast iron soil pipe by hand.

A. Determine distance hub adds to over-all pipe measurements.
B. Measure desired length, allowing for hub correction.
C. Mark a cutting line, true to the pipe, and position pipe on a 2 x 4 block.
D. Sitting astride the pipe, short end in front of you, and wearing safety glasses, score pipe with a hammer and chisel. Alternately score and turn pipe until pipe drops off.

III. Students cut cast iron soil pipe by hand.

METAL

CONTENT TITLE: Cast Iron Soil Pipe Operations

SUB OBJECTIVE 2: The student will demonstrate ability to properly prepare and complete a vertical bell and spigot soil pipe joint.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the preparation and sealing of vertical bell and spigot joints.

   A. Position pipes in a telescope position, spigot resting in hub.
   B. Alternately stuff joint with oakum and pack with yarning iron until joint is packed to within an inch of the top.
   C. Fill joint with molten lead, observing safety precautions: i.e., wear safety goggles; preheat ladle before dipping into lead pot and hold head well away from pot while dipping; stand on opposite side of joint while pouring.
   D. When lead has cooled, set up with packing iron, hammering in four places.
   E. Tamp or caulk outside of joint first, followed by inside.
   F. Check for smoothness and absence of cracking.

II. Students prepare and caulk a vertical bell and spigot joint.

METAL

CONTENT TITLE: Cast Iron Soil Pipe Operations

SUB OBJECTIVE 3: The student will demonstrate ability to make a horizontal joint (bell and spigot) in cast iron soil pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates connecting cast iron soil pipe in the horizontal position.

A. Obtain a plank which is long enough to extend beyond both ends of the assembled pipe.
B. Support first section of pipe on plank by laying pipe on two bricks, positioned on edge, one under bell end of pipe, the other under the spigot end.
C. Insert spigot end of second pipe into bell of previously positioned pipe, supporting its bell end with another brick placed edge-wise.
D. Align pipe with plank and ensure that joint is "socked up."
E. Pack joint with oakum as done in vertical joints.
F. Warm a yarning rope (joint runner) over hot lead, and wrap around joint. Tap up to the hub immediately. When cool, break top ends of rope down to form a gauge or channel for the molten lead.
G. Fill joint with lead, holding head as far away from the pouring area as possible.
H. Allow lead to cool. Then trim excess with a chisel.
I. Caulk inside and outside of joint and dress.

II. Students make a horizontal connection in cast iron soil pipe.

METAL

CONTENT TITLE: Cast Iron Soil Pipe Operations

SUB OBJECTIVE 4: The student will demonstrate ability to make a compression joint in cast iron soil pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses tools and materials, such as pulling tools, gaskets and gasket lubricants.

II. Instructor demonstrates making a compression joint.

A. Fold gasket into properly cleaned hub.
B. Apply lubricant to inside of gasket and to cleaned spigot of pipe.
C. Place spigot end into gasket.
D. Push, pull or drive the spigot into the gasketed hub with pulling tool or other suitable device.

III. Students make a bell and spigot compression joint.

METAL

CONTENT TITLE: Cast Iron Soil Pipe Operations

SUB OBJECTIVE 5: The student will demonstrate ability to make a no-hub joint in cast iron soil pipe.

SUGGESTED ACTIVITIES: (Student and Teachers)

I. Instructor introduces tools and materials, such as torque wrenches and gaskets with shields.

II. Instructor demonstrates making a no-hub joint.

A. Place gasket on end of one pipe.
B. Place stainless steel shield and clamp assembly on end of other pipe.
C. Firmly seat ends of pipe into gasket.
D. Slide shield and clamps into position over gasket.
E. Tighten clamps alternately and firmly (use about 48 inch pounds of torque).

III. The student makes a joint with no-hub cast iron soil pipe.

METAL

CONTENT TITLE: Cast Iron Soil Pipe Operations

SUB OBJECTIVE 6: The student will demonstrate ability to join cast iron soil pipe using mortar.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates joining cast iron soil pipe with mortar.

A. Demonstrate use of pointing trowel.
B. Mix mortar (one part cement, two parts coarse sand) and sufficient water to bring to the consistency of a light paste.
C. Position pipe in a trench so that the length of pipe is solidly supported.
D. Dig a hole at the joint end of pipe 8 to 10 inches in front of, deep, and on each side of joint to allow working room.
E. Wearing protective gloves, dip a tightly wound piece of oakum into mortar and yarn into the hub, ensuring that joint is "socked up."
F. Use a pointing trowel to press mortar into joint. Trowel off at about a 30° slope from hub.

II. Students join cast iron soil pipe with mortar.

METAL

CONTENT TITLE: Cast Iron Soil Pipe Operations

SUB OBJECTIVE 7: The student will demonstrate ability to screw pipe to bell and spigot cast iron soil pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates joining screw pipe to cast iron soil pipe.

A. Thread screw pipe up on Tucker fitting.
B. Position spigot end of Tucker fitting into hub of soil pipe.
C. Yarn and caulk joint as for other joints.

Note: A coupling or an increaser may be used in place of a Tucker fitting.

II. Students join screw pipe to bell and spigot soil pipe.

METAL

CONTENT TITLE: Cast Iron Soil Pipe Operations

SUB OBJECTIVE 8: The student will demonstrate ability to join cast iron soil pipe to bituminized fiber pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces adapter (taper for bituminized pipe and hub for cast iron).

II. Instructor demonstrates joining soil and bituminized fiber pipes.

A. Drive tapered adapter onto bituminized fiber pipe.
B. Position spigot of cast iron in hub side.
C. Yarn to within one inch of face of hub.
D. Pour with compound or fill with cement.
E. Allow compound or cement to harden.

Note: For bituminized fiber pipe that does not have a tooled (tapered) end there is a double hubbed coupling to caulk both ends.

III. Students cast iron and bituminized fiber pipes.

METAL

CONTENT TITLE: Cast Iron Soil Pipe Operations

SUB OBJECTIVE 9: The student will demonstrate ability to cut clay pipe with a cold chisel and hammer.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates cutting glazed clay pipe.

A. Measure and mark clay pipe all around.
B. Place mark on mound of dirt or a 2 x 4 and cut through glaze using light hammer blows and a sharp chisel. Wear safety glasses.
C. Rotate pipe and score lightly until pipe separates.

Note: Clay pipe can also be cut by scoring all around with a grinder, or it may be cut with an abrasive saw.

II. Students cut glazed clay pipe with hammer and chisel.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to cut, bend and fasten screw pipe for hot and cold water supply lines and to run gas lines to and install gas fired water heaters.

SOURCES OF INFORMATION

Department of the Army, Plumbing and Pipefitting, TM5-551K, 1971. (Order from Government Printing Office, Document No. D101.11: 5-551K).

Copper and Brass Pipe and Tube Bending Handbook, (Copper Development Association: 405 Lexington Avenue, 57th Floor, New York, New York 10017).

D'Arcangelo and Guest, Mathematics for Plumbers and Pipefitters, (DelMar Publishers: P. O. Box 5087, Albany, New York).

Greenlee Bender Booklet, (Greenlee Bros. & Co.: 2136 12th Street, Rockford, Illinois 61101).

The Imperial Tube Working Handbook, (Imperial-Eastland Manufacturing Co.: 6300 Howard Street, Chicago, Illinois 60648).

Slater, Harry, Plumbing I and II, (DelMar Publishers: P. O. Box 5087, Albany, New York 12205), 1958. (2 books)

Continued...

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to cut, bend and fasten screw pipe for hot and cold water supply lines and to run gas lines to and install gas fired water heaters.

(Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Linear measurements
  - Whole numbers
  - Fractions
  - Decimals
  - Angles and degrees
- Sizing
  - Pipe and tubing
  - Pipe threading dies
  - Pipe threads

Communication

- Manufacturer's literature
- Related safety information
  - Tools and working materials
  - Gas operated equipment
- Building Codes

Science

- Pressure
  - Liquids
  - Gas
- Thermocouple operation
- Venting and flues
- Insulation materials
- Safety relief valves

METAL

CONTENT TITLE: Screw Pipe Operations

SUB OBJECTIVE 10: The student will demonstrate ability to correctly and safely operate pipe holding devices.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the side opening bench vise.

A. Explain and discuss vise placement.
B. Discuss uses of the vise such as operation with cutting and threading tools and use in pipe bending with the hickey bar.

II. Instructor demonstrates use of the side opening bench vise.

A. Select pipe to be held in vise.
B. Open vise just wide enough to receive pipe.
C. Insert pipe.
D. Turn handle of vise clockwise until snug.
E. Extend vise handle to the right and pull until very tight.

III. Students operate a side opening vise.

METAL

CONTENT TITLE: Screw Pipe Operations

SUB OBJECTIVE II: The student will demonstrate ability to cut steel pipe to specified dimensions using a single wheel cutter.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates cutting steel pipe with a single wheel cutter.

A. Select, measure and mark pipe to be cut.
B. Mount pipe in vise with shortest piece protruding about six inches.
C. Position cutters under pipe and raise cutter to engage pipe.
D. Close cutter and ensure that both guide wheels are in contact with pipe.
E. Tighten cutter very lightly and make a ring on the pipe by turning cutter one revolution (full round).
F. Ensure that cutter wheel tracks.
G. Tighten "T" handle one quarter turn and move cutter backward and forward, making a deeper ring around the pipe.
H. Continue turning "T" handle one quarter turn and moving forward and back around pipe until the pipe gives. Tighten slightly, turn and remove the pipe.

Note: Grasp protruding end of pipe and avoid dropping it.

II. Students cut a piece of steel pipe.

METAL

CONTENT TITLE: Screw Pipe Operations

SUB OBJECTIVE 12: The student will demonstrate ability to use a spiral reamer to remove burrs and other irregularities from cut pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces the spiral reamer.

A. Explain and discuss types of reamers.
B. Explain operation of spiral reamer.
C. Note that nearly all pipe operations require reaming.

II. Instructor demonstrates reaming pipe.

A. Secure pipe in a vise.
B. Pick up reamer, grasping long handle in dominant hand and short handle in the other hand.
C. Insert spiral tapered end in pipe and ream.

III. The student reams a pipe with the spiral reamer.

METAL

CONTENT TITLE: Screw Pipe Operations

SUB OBJECTIVE 13: The student will demonstrate ability to thread pipe using ratchet dies.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates cutting a pipe thread with a ratchet die.

   A. Select a measured, cut and reamed piece of pipe.
   B. Mount pipe in vise.
   C. Pick up die with long handle in dominant hand and guide die onto pipe with other hand.
   D. Apply pressure to face of die and start threads.
   E. Alternately oil dies and advance threading tool until one thread extends beyond dies.
   F. Remove die and clean.

II. Students thread steel pipe with a ratchet die.

METAL

CONTENT TITLE: Screw Pipe Operations

SUB OBJECTIVE 14: The student will demonstrate ability to repair broken or burst screw pipe waterlines.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor explains and discusses tools and materials used, such as hacksaws, pipe wrenches, hammers, pipes, nipples, unions, pipe dope, brushes and rags.

II. Instructor demonstrates repairing broken or burst steel pipe waterline.

A. Cut off water at meter and water supply valve to the water meter.
B. Open lowest and highest faucets to drain pipes.
C. Measure broken waterline taking EE measurement and allowing for makeup. This will be an over all measurement.
D. Cut and remove pipe from fittings.
E. At pipe bench, dope one end of a nipple and attach a union.
F. Attach nipple and union to a piece of pipe long enough for repair piece.
G. Measure ETOE (over all) over the union; cut; ream and thread.
H. Wipe away excess pipe dope, dope nipple end and tighten in place.
I. Tighten connections.
J. Check faucets.
K. Turn water on at meter.
L. Turn valve on at meter.
M. Flush all lines.
N. Check for leaks and clean up.

III. Students repair a broken waterline.

METAL

CONTENT TITLE: Screw Pipe Operations

SUB OBJECTIVE 15: The student will demonstrate ability to remove an old water heater and replace the plumbing for a new one.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the use of local codes in installing water heaters.

   A. Discuss determining required heater capacity.
   B. Discuss ventilation.
   C. Discuss piping -- its types and sizes.
   D. Discuss T&P valves -- their sizes, locations and discharges.

II. Instructor demonstrates removal and connection of water service.

   A. Disconnect utilities.
   B. Relieve water lines, break connections to old heater and allow to drain.
   C. Remove old plumbing, position the new heater, check for the presence of a dip tube and install the fittings on the new heater.
   D. Install new plumbing, relief valves and lines.
   E. Close boiler drain and cold water supply valve at the wall.
   F. Close other faucets, leaving the tube faucets open.
   G. Turn on water at meter; following, shut off cold tap at tub.
   H. Open cold water supply valve to heater, and when heater is filled, close all water faucets and check for leaks.

III. Students install a water heater.

METAL

CONTENT TITLE: Screw Pipe Operations

SUB OBJECTIVE 16: The student will demonstrate ability to install a flue or vent on a gas fired water heater in accordance with applicable city ordinances.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing a flue or vent on a gas fired water heater.

   A. Remove draft diverter and ensure that baffle is in place.
   B. Replace draft diverter and ensure that relief opening is not obstructed.
   C. Replace flue or vent to draft diverter.

II. Student installs a flue or vent on a gas fired water heater.

METAL

CONTENT TITLE: Screw Pipe Operations

SUB OBJECTIVE I7: The student will demonstrate ability to replace the gas connections to a gas fired water heater. The connections should be leak free and no fuel should be allowed into the atmosphere of the work area during the operations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing gas lines to a replaced water heater.

   A. If old lines are used, clean and remove burrs.
   B. Prepare and install new pipe; install drip leg at low point of the gas lines.
   C. Turn off gas at plug cock in supply line to heater; ensure that valves to other gas fixtures are closed.
   D. Turn gas on at meter and light pilots on other gas fixtures in the residence.
   E. Open the plug cock, check for leaks and light pilot to heater.
   F. Adjust heater for desired temperature.

II. Student installs a gas fired water heater.

METAL

CONTENT TITLE: Screw Pipe Operations

SUB OBJECTIVE 18: The student will demonstrate ability to calculate the length of pipe consumed in a bend and to use a hickey bender to bend steel pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates determining length of pipe consumed in a bend.

   A. Describe techniques of calculation used to determine pipe consumption when radius is known.
   B. Describe method of determining minimum desirable radius of bend.

II. Instructor demonstrates making a 90° bend of the determined radius.

   A. Determine radius of bend (6 x d, where d = diameter of pipe).
   B. Determine length of pipe needed for a 90° bend on the determined radius.
   C. Mark end to center measurement on pipe (ETOC).
   D. Move back from that mark and mark calculated radius (in this case 4-1/2").
   E. Move back from mark made in step D and mark subtended arc (amount of pipe required).
   F. Position either mark at face of vise and position hickey on bender at other mark. (In this case 7-1/16" from other mark.)
   G. Pull hickey bar to just under 90°. Alternately pull and check angle with a square, until a 90° bend has been accomplished.

III. Students calculate and bend pipe with a hickey bender.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to cut and fasten bituminized fiber pipe.

SOURCES OF INFORMATION

Department of the Army, Plumbing and Pipefitting, TM5-551K, 1971. (Order from Government Printing Office, Document No. D101.11: 5-551K).

Slater, Harry, Plumbing I and II, (DelMar Publishers: P. O. Box 5087, Albany, New York 12205), 1958. (2 books)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material sizing

Communication Skills

- Related safety - tools and equipment
- Manufacturer's literature

Science

- Various piping materials
  - Cast iron
  - Steel
  - Copper
  - Asbestos
  - Bituminous fiber
  - Plastic
  - Tile

CONTENT TITLE: Other Pipe Operations

SUB OBJECTIVE 19: The student will demonstrate ability to cut bituminized fiber pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses types and usage of bituminized fiber pipe.

II. Instructor demonstrates cutting bituminized fiber pipe.

A. Measure and mark position of cut.
B. Hold pipe on bench or in vise.
C. Cut with a coarse-tooth saw adding kerosene or diesel oil to blade to improve its cutting operation.

III. Student cuts bituminized fiber pipe.

CONTENT TITLE: Other Pipe Operations

SUB OBJECTIVE 20: The student will demonstrate ability to join bituminized fiber pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates joining bituminized fiber pipe with tapered ends.

A. Place tapered coupling on taper end of pipe.
B. Place tapered end of another length of pipe in other end of tapered coupling.
C. Put one end of pipe against a flat, solid surface.
D. Drive other end of pipe into coupling using flat board and hammer or pulling tool. Exercise care to avoid driving pipe too far.

II. The students join bituminized pipe.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to cut and fasten asbestos-cement pipe.

SOURCES OF INFORMATION

Department of the Army, Plumbing and Pipefitting, TM5-551K, 1971. (Order from Government Printing Office, Document No. D101.11: 5-551K).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Estimating measurements

Science

- Asbestos materials
- Seals, sealants and lubricants

Communication Skills

- Manufacturer's literature
  - Pipe
  - "O" ring seals

METAL

CONTENT TITLE: Other Pipe Operations

SUB OBJECTIVE 21: The student will demonstrate ability to cut asbestos-cement pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses types and uses of asbestos cement pipe.

II. Instructor demonstrates cutting asbestos-cement pipe.

A. Measure and mark position of cut.
B. Hold pipe in vise or on work place.
C. Cut, using a saw with coarse teeth such as a buck saw or abrasive blade power saw.

III. Students cut asbestos-cement pipe.

METAL

CONTENT TITLE: Other Pipe Operations

SUB OBJECTIVE 22: The student will demonstrate ability to make an asbestos-cement pipe joint.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces tools and materials.

A. Special machining tool.
B. "O" rings.
C. Lubricant.
D. Pulling tool.
E. Test gauge.

II. Instructor demonstrates making an asbestos-cement pipe-joint.

A. Lay pipe in place.
B. Clean coupling or fitting and end of pipe to be joined with water.
C. Lubricate "O" ring using special lubricant recommended by pipe company.
D. Position ring on machined end of pipe. Care should be taken in placement.
E. Push pipe into coupling or fitting.
F. Pull pipe and coupling or fitting together with pulling tool.

Note: Leave ends of pipe about 1/4" apart in the coupling or fitting to allow for expansion and flexibility.

G. After joining pipe, insert test gauge into hub of coupling or fitting to determine that rings are in proper position.

III. Students make an asbestos-cement joint.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to cut and fasten copper tubing using the soft solder method.

SOURCES OF INFORMATION

Department of the Army, Plumbing and Pipefitting, TM5-551K, 1971. (Order from Government Printing Office, Document No. D101.11: 5-551K).

Copper and Brass Pipe and Tube Bending Handbook, (Copper Development Association: 405 Lexington Avenue, 57th Floor, New York, New York 10017).

The Imperial Tube Working Handbook, (Imperial-Eastland Manufacturing Co.: 6300 Howard Street, Chicago, Illinois 60648).

Sosnin, H. A., The Theory and Technique of Soldering and Brazing of Piping Systems, (NIBCO Inc.: Elkhart, Indiana 46514).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Sizing of copper tubing
- O.D. and I.D. measurements
- Computing material estimates
  - Unit costs
  - Units required to complete job
  - Use of catalogs
  - Discount and sales tax

Communication Skills

- Manufacturer's literature
- Related safety
  - Use of solder and fluxes
  - Use of torches
  - Care and prevention of burns
  - Soldering fumes

METAL

CONTENT TITLE: Other Pipe Operations

SUB OBJECTIVE 23: The student will demonstrate ability to join copper by the soft solder method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates joining copper pipe by the soft solder method.

A. Measure, cut and remove burrs from ends of pipe to be joined.
B. Size end with sizing tool if out of round.
C. Thoroughly clean end of tube and inside of socket fitting using inside and outside brushes, emory cloth or steel wool. After cleaning, do not breathe on or touch joining faces.
D. Flux pipe with a thin coating of flux immediately after cleaning. Avoid extending fluxed area more than 1/4" beyond area to be soldered.
E. Flux inside of socket immediately after cleaning.

Note: Flux is harmful to the eyes; do not apply with fingers.

F. Apply heat.
G. Test the joint by touching solder to the face of the fitting. When solder melts, remove heat and feed solder from the bottom of a horizontal joint. Capillary action will draw solder into the joint.
H. Wipe excess solder off with a cloth. Allow pipe to cool down before applying water pressure.

II. Students join copper pipe using the soft solder method.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to cut and fasten PVC pipe using both solvent and polyfusion processes and to join PVC pipe to a variety of other types of pipe.

SOURCES OF INFORMATION

Department of the Army, Plumbing and Pipefitting, TM5-551K, 1971. (Order from Government Printing Office, Document No. D101.11: 5-551K.)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Material sizing
- PSI measurements

Communication Skills

- Manufacturer's literature
- Vocabulary work
- Building code requirements

Science

- Properties of plastics
- Fastening techniques
- Critical temperatures
- Sweating and condensation
- Connecting dissimilar materials

METAL

CONTENT TITLE: Other Pipe Operations

SUB OBJECTIVE 24: The student will demonstrate ability to join PVC pipe using solvent cement.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates joining PVC using solvent cement.

A. Discuss types and applications of PVC; i. e., PVC, PVC Type I, PVC Type II, etc.
B. Measure, mark and cut pipe square using a hand saw and mitre box. Mechanical cut off saws or cutters may be used, but bead must be removed.
C. Taper outside edge of pipe about 1/16", 10° to 15° slope.
D. Clean and dry pipe and fitting socket. Use a clean rag.
E. Using a scrubbing motion, apply primer to inside of socket of fitting to dissolve the inside surface.
F. Likewise, dissolve surface of male end of pipe to the depth of the fitting socket.
G. Brush inside of socket with primer again.
H. Apply filler cement liberally to male end of pipe.
I. Apply filler cement to inside of socket, using straight outward strokes to keep excess filler out of socket. This will prevent solvent damage to pipe.
J. Apply second coat of filler to pipe.
K. While inside surface of socket and outside surface of pipe are soft and wet, place male end of pipe into socket of fitting and give the fit 1/4 turn, if possible. Force the pipe to the bottom of the socket and hold to center for about 30 seconds to allow cement to set.
L. Wipe excess cement from pipe at end of fitting socket. Do not disturb pipe further until cement is completely set; setting time is specified by cement or pipe manufacturers. Perform no pressure tests until cement is cured.

II. Student joins PVC using solvent cement.

METAL

CONTENT TITLE: Other Pipe Operations

SUB OBJECTIVE 25: The student will demonstrate ability to join plastic pipe using the polyfusion method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates making a polyfusion joint.

A. Measure depth of socket fitting and mark on end of pipe.
B. Wipe socket of fitting and end of pipe clean.
C. Attach rubber compression bands to quick-release band (color coded for size) on outside of fitting.
D. Place handle of tool in vise and test heat of tool with a Thermomelt stick.
E. When Thermomelt stick begins to melt, place the pipe and fitting in the tool for a few seconds; a trial piece could be used to test time.
F. When pipe and fitting socket become "tacky" (you can judge this by pulling pipe and fitting off and on just a fraction), remove from tool and insert pipe into socket of fitting a little off true center. Twist to true center when "socked up." Do not force.
G. Hold in position for a few seconds (15 to 30) to allow to set and put aside to cure.
H. Clean tool by brushing with wire brush and wiping with clean cloth.

II. Students make a polyfusion joint.

METAL

CONTENT TITLE: Other Pipe Operations

SUB OBJECTIVE 26: The student will demonstrate ability to join PVC pipe to screw or caulk-type pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates making a transition joint.

A. For joining PVC to screw pipe, arrange so that PVC may be the male portion of the joint.
B. Apply teflon tape to male thread of PVC.
C. Apply Crisco or library paste to threaded portion of fitting.
D. Screw PVC tight into fitting.
E. To join PVC to Manoff fittings, use teflon on thread of plastic adapter. Screw adapter into Manoff type fitting.
F. Insert Manoff fitting into bell of caulk pipe.
G. Yarn and lead (compound may be used in this type of fitting also) as for cast iron soil pipe.
H. PVC may be joined similarly to glass or copper by use of adapting flanges.

II. Students make transition joints.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to rough in house drains and ground lines, and soil stacks and to lay a sewer.

SOURCES OF INFORMATION

Department of the Army, Plumbing and Pipefitting, TM5-551K, 1971. (Order from Government Printing Office, Document No. D101.11: 5-551K).

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight & McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Slater, Harry, Plumbing I and II, (DelMar Publishers: P. O. Box 5087, Albany, New York 12205), 1958. (2 books)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Plumb and level
- Scale measurements
- Estimating time and materials
- Use of catalog numbering system
- Reading charts and numbering indexes

Science

- Stacks and vents
- Examination of rough in system

Communication Skills

- Blueprint interpretation
- Bills of material - practice in writing and telephoning information
- Working drawings
- Catalog descriptions and pricing
- City specifications

METAL

CONTENT TITLE: Drainage and Ventilation

SUB OBJECTIVE 27: The student will demonstrate ability to rough-in house drains and ground lines.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses house drains, clean outs, tank water valves and floor drains.

II. Instructor demonstrates installing house drains and ground lines.

A. Read plans and specifications.
B. Locate openings for soil stack, floor drains, sink waste and clean outs.
C. Determine elevations.
D. Draw layout (plots isometric) of house drain and outlets.
E. Make up bill of materials.
F. Dig and level trenches.
G. Place fittings and pipe in trench.
H. Check measurements.
I. Rough-in only to floor line. Install sleeves where pipes come through slab.
J. Plug ends of lines and install water head required by local code.
K. Backfill and tamp dirt well.

III. Students install house drains.

METAL

CONTENT TITLE: Drainage and Ventilation

SUB OBJECTIVE 28: The student will demonstrate ability to rough-in a soil stack.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses soil pipe, waste pipe, code requirements, sizes of soil stacks and the necessity for increasing their size at the roof, types of flashings, down spouts and rain leaders.

II. Instructor demonstrates installing soil stacks and vents.

A. Locate soil stack connection.
B. Make an isometric and elevation drawing of soil stack in detail.
C. Draw up bill of materials.
D. Cut building frame work where necessary.
E. Install stack, check for plumb and make sure it is well supported at all fittings.
F. Place backing for wall hung fixtures.

III. Students install a soil stack and vents.

METAL

CONTENT TITLE: Drainage and Ventilation

SUB OBJECTIVE 29: The student will demonstrate ability to lay the house sewer.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses types and applications of sewer pipes, applicability of local and other codes and safety considerations involved, such as shoring or sheeting trenches, barricading and redlighting.

II. Instructor demonstrates laying a house sewer.

A. Local city sewer outlet or place where tie-in is to be made.
B. Check plans and specifications as to type of pipe materials to be used.
C. Take city sewer elevation and house drain elevation and calculate slope.
D. Make up bill of materials.
E. Dig tench.
F. Put pipe together with approved materials.
G. Test.
H. Have approved by local inspector.
I. Backfill trench and tamp down.

III. Students lay a house sewer.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to install both bowl-type and flush valve type water closets.

SOURCES OF INFORMATION

American Standard Fixtures and Fittings Catalog, (American Standard, Inc.: P. O. Box 2003, New Brunswick, New Jersey 08903).

Department of the Army, Plumbing and Pipefitting, TM5-551K, 1971. (Order from Government Printing Office, Document No. D101.11: 5-551K.)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Material sizing
- Tool sizing
- Job estimating

Science

- Types of float and pressure valves
- Gaskets and seals
- Water pressure and leaks

Communication Skills

- Manufacturer's literature
- Related safety
  - Use of torches
  - Burns
  - Use of tools
  - Lifting and moving heavy objects
  - Working in cramped areas
- Vocabulary work

CONTENT TITLE: Installation of Fixtures

SUB OBJECTIVE 30: The student will demonstrate ability to install a top spud water closet (bowl) with flush valve.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces the different types of water closets such as wash out, wash down, siphon and frost proof water closets.

II. Instructor demonstrates attaching floor mount bowls to lead stubs.

Note: Check all measurements before beginning job.

A. Spread drop cloth on floor.
B. Remove wrapping from lead stub.
C. Clean floor around stub.
D. Place brass floor ring over lead stub, bevel side up. Ensure that ring is flat on floor and level.
E. Cut lead off stub even with top of floor flange.
F. Put large ball of rag or test plug in lead opening.
G. Remove brass floor ring and tin machined taper.
H. Clean burrs off stub and cut.
I. Replace floor flange on lead stub, and with dresser and bending iron, flare leads to meet bevel of flange on ring.
J. Ensure that bolt holes or mounting bolts are arranged so that bolts will be parallel to wall.
K. Clean lead with shave hook from 1/4" to 1/2" back from the brass. Use candle on cleaned lead.
L. Solder lead to brass floor flange; a copper or prestolite torch can be used for this.
M. Insert closet bolts in holes in flange.
N. Put wax ring or putty around 4" hole, about 2" wide and 1-1/4" to 1-1/2" high.
O. Clean outlet of bowl and be sure to check that floor where it will sit is clean (bowl can be easily broken).

Continued...

METAL

CONTENT TITLE: Installation of Fixtures (Continued)

SUB OBJECTIVE 30: The student will demonstrate ability to install a top spud water closet (bowl) with flush valve.

SUGGESTED ACTIVITIES: (Students and Teachers)

P. Remove bag or test plug.
Q. Pick bowl up by inside rim, one hand on each side. Straddle ring and place bowl outlet into lead stub. Be careful not to disturb wax ring or putty.
R. Press bowl down gently, lining it up with wall and floor.
S. Put washers and nuts on closet bolts.
T. Draw nuts down gently but firmly. Apply weight on bowl to set bowl in.
U. Level bowl, using wood shims if necessary.
V. Pull closet nuts down firmly. Cut bolts and cap.
W. Install flush valve.
X. Test for leaks.
Y. Grout under edge of bottom of bowl (cement or plaster of Paris). This provides neatness and support for bowl as well as keeping water from going under bowl.

III. Students set top spud bowl on lead stub.

METAL

CONTENT TITLE: Installation of Fixtures

SUB OBJECTIVE 3I: The student will demonstrate ability to install a flush valve.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses flush valves.

A. Discuss water pressure and volume requirements.
B. Discuss types.
C. Discuss use of vacuum breakers.

II. Instructor demonstrates installing a flush valve.

A. Check out rough-in measurements.
B. Determine and gather tools and materials needed.
C. Measure nipple needed; cope with teflon and screw in. When water control valve is made up, the center of the outlet should be in line with the center of the spud in the top of the bowl.
D. Place wall flange on nipple.
E. Position flush valve on water control valve and tighten hand tight.
F. Level flush valve and measure over-all for tail piece and vacuum breaker.
G. Put a spud wrench inside bowl spud; hold back up while tightening outside nut with outside spud wrench (or with monkey wrench) to take up slack. A strap wrench may be needed to tighten tail piece into vacuum breaker.
H. Cut and ream tail piece to fit.
I. Remove flush valve from control valve.
J. Put vacuum breaker and tail piece onto flush valve, hand tighten and ensure that gasket is in place.
K. Install flange on spud at top of bowl.
L. Place friction nut and "O" ring on tail piece.

Continued...

METAL

CONTENT TITLE: Installation of Fixtures (Continued)

SUB OBJECTIVE 3I: The student will demonstrate ability to install a flush valve.

SUGGESTED ACTIVITIES: (Students and Teachers)

M. Insert tail piece into spud; line up flush valve with control valve.
N. Tighten nut from flush valve to control valve.
O. Tighten nut at spud hand tight. Be sure flush valve is plumb and level. Hold in place and tighten nut at control valve with flat jaw wrench.
P. Tighten nut at spud snugly. Should it leak, it may be further tightened. Avoid moving spud.
Q. Tighten all nuts on valves snugly.
R. Turn water on slowly and check for leaks.

III. Students install a flush valve.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to install domestic hot and cold water service and to connect this service to the city water supply, in accordance with applicable city codes.

SOURCES OF INFORMATION

Department of the Army, Plumbing and Pipefitting, TM5-551K, 1971. (Order from Government Printing Office, Document No. D101.11: 5-551K).

Lux, Donald K. and Willis E. Ray, The World of Construction, (McKnight & McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Slater, Harry, Plumbing I and II, (DelMar Publishers: P. O. Box 5087, Albany, New York 12205), 1958. (2 books)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Material and equipment sizing
- Gauge interpolation
- General math review

Science

- Safety devices on water heaters
- Thermostats
- Thermocouple operation
- General science review

Communication Skills

- Manufacturer's literature
- City codes
- Blueprint interpretation
- Apprenticeship information
- Post-secondary education plans
- Surveying job market
- Career options available after graduation

METAL

CONTENT TITLE: Water Supply

SUB OBJECTIVE 32: The student will demonstrate ability to install a house service in accordance with applicable ordinances.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces and discusses aspects of installing house service such as local codes, materials used in house service, types of joints used for house service, sizing house services, valves used in house service installations and water meters.

II. Instructor demonstrates installing house service.

A. Read plans and specifications.
B. Locate city corporation (cock or tape).
C. Size pipe.
D. Dig separate trench.
E. Measure piping from house line to corporation cock, allowing for meter, fittings and pressure relief valve, should this be required.
F. Install pipe and put a cut off valve with waster at the house. Also install one at the meter. (This is required in most places.)
G. Tie city corporation cock, stop and waste together with a "jumper" the same size as the meter.
H. Test line with city pressure.

III. Students install a house service line.

METAL

CONTENT TITLE: Water Supply

SUB OBJECTIVE 33: The student will demonstrate ability to install domestic hot and cold water lines.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation of domestic hot and cold water line.

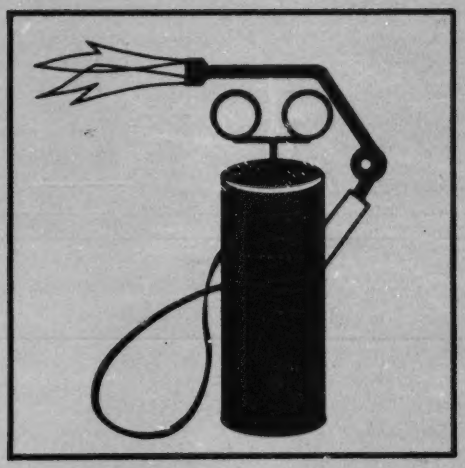
   A. Discuss sources and pressures.
   B. Discuss pressure regulator valves.
   C. Discuss pipe sizing.

II. Instructor demonstrates installing hot and cold water.

   A. Read plans and specifications.
   B. Locate all openings.
   C. Make isometric sketch of hot and cold water lines.
   D. Measure up job, placing all measurements on isometric drawing. Develop as much piping as possible at bench. All piping under the slab should be covered with about 4" of sand or fill dirt. Do not allow copper or plastic to come in contact with waste lines or reinforcing bars. Use heavy tape on pipe or use insulation.
   E. Sleeve all pipe coming through slab and use coiled copper or coiled plastic pipe below slab. Make necessary joints above slab.
   F. Use winged tee's at fixture outlets to bolt steadily in place.
   G. Install air chambers or shock absorbers at all fixtures.
   H. Cap all openings.
   I. Perform hydrostatic test on lines following local codes.

III. Students install hot and cold water lines in a slab project.

PIPEFITTING



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METAL

OVERALL OBJECTIVE: The student will demonstrate ability to measure, cut, lay out, bend and fabricate pipe, sheet metal and steel plate to fabricate a small heat exchanger.

SOURCES OF INFORMATION

Frankland, Thomas W., The Pipe Fitter's and Pipe Welder's Handbook, (Direct orders to: Crowell Collier MacMillan Distribution Center, Front and Brown Streets, Riverside, New Jersey 08075), 1969.

Pipe Fitter's Manual, (Tube Turns, Division of Chemetron Co.: Louisville, Kentucky 40201).

Sosnin, H. A., The Theory and Technique of Soldering and Brazing of Piping Systems, (NIBCO Inc.: Elkhart, Indiana 46514), 1971.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measurements
  - Whole numbers
  - Decimals
  - Fractions
- Degrees and angles
- Diameter and radius
- Formula computations
- Material and tool sizing
- Scale measurements

Science

- Metals and heating of metals
- Soldering theory
  - Fluxes
  - Capillary action
- Welding of metals

Communication Skills

- Blueprint reading
- Vocabulary development
- Working drawings
- Using tables, charts and graphs
- Related safety - using torches
  - Electric hand tools
  - Heated metals

METAL

CONTENT TITLE: Pipe Operations

SUB OBJECTIVE I: The student will demonstrate ability to thread steel pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses threading steel pipe.

A. Point out that it is advantageous to develop a consistent pattern for threading pipe. In this way, calculations to allow for fittings will become automatic and math, in general, will be reduced.

B. Discuss standard threading of pipe of 0.5" to 2.0" diameter; thread this pipe to make up 5/8". If pipe is protruding 5/8" behind die, fitting will make up 5/8".

C. Discuss standard threading of pipe of 2.0" up; thread this pipe to make up 1.9". If pipe is protruding 1.0" behind die, fitting will make up 1.0".

II. Instructor demonstrates threading pipe.

A. Select a measured, cut and reamed piece of pipe.

B. Mount pipe in vise.

C. Pick up die with long handle in dominant hand and guide die onto pipe with other hand.

D. Apply pressure to face of die and start threads.

E. Alternately oil dies and advance threading tool until one thread extends beyond dies.

F. Remove die and clean.

III. Students thread steel pipe.

METAL

CONTENT TITLE: Pipe Operations

SUB OBJECTIVE 2: The student will demonstrate ability to bend steel pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates bending pipe.

A. Discuss limits of bending operations, i.e. mention that bend radius should not be less than 5 times the outside diameter of the pipe to be bent.

B. Discuss protecting pre-threaded pipe by fitting threads with caps, old fittings, etc. for protection.

C. Demonstrate calculating length of pipe consumed in a bend. The formula is $\pi = (2r)/f$ where:

$\pi =$ 3.1416
$r =$ radius of bend
$f =$ fraction of a circle consumed in the bend. (For a 90° bend, $f = 4$).

For example: We wish to bend a 1-1/2" pipe 90°. How much pipe will be consumed in the bend? The O.D. of a 1-1/2" pipe is approximately 1.9", or roughly 2". The bend radius, then, should be 2 x 5 = 10". Length of pipe consumed is 3.1416 x 20/4 = 15.71".

D. Measure off any fitting requirements.

E. Mark back from fitting mark length of pipe which will be consumed.

F. Clamp pipe in a chain vise at tangent point.

G. Heat pipe with a torch until cherry red, over the entire length of the bend.

H. Allow pipe to cool until an even "dark" color.

I. Bend pipe over desired radius with a hickey bar.

II. Students bend steel pipe.

METAL

CONTENT TITLE: Copper Pipe

SUB OBJECTIVE 3: The student will demonstrate ability to join copper pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates soldering copper pipe.

A. Prepare the pipe surfaces to be joined by thoroughly cleaning with a mild acid or cleaning compound.
B. Wipe surfaces dry of any cleaning compound or acidic solvents.
C. Polish all surfaces to be joined with emory cloth. Do not touch or breathe on any of the surfaces to be joined.
D. Using a clean rag, or brush designed for the purpose, apply a thin layer of soldering flux (paste) to the joining surfaces.
E. Fit pipes together and check alignment, fit, etc.
F. Apply heat with soldering copper or torch, preferably to top of joint. Heat until solder touched to the opposite side (bottom) of joint will melt.
G. Apply solder, allowing capillary action to draw solder into the joint. Do not apply heat directly to solder.

II. Students join copper pipe by soldering.

METAL

CONTENT TITLE: Threading and Tapping

SUB OBJECTIVE 4: The student will demonstrate ability to thread and tap steel plate.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates tapping steel plate.

A. Measure and locate position of hole.
B. Use center punch, if necessary, to make a starter point.
C. Drill pilot hole. Select appropriate drill size either from tables, or from mark frequently found on size of tap.
D. Start thread by starting tap in hole. It is not necessary to run tap completely through hole.
E. Remove tap and start threaded pipe. Rotate the pipe, letting it thread its own way. This way the thread will watch the pipe exactly and the fitting will be tighter.

II. Students thread and tap steel plate.

METAL

CONTENT TITLE: Coil Bundles

SUB OBJECTIVE 5: The student will demonstrate ability to fabricate a coil bundle.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates and discusses fabricating the coil bundle.

   A. Discuss reading blueprint and determining necessary materials from bill of materials (bill of lading).
   B. Discuss types of straight pipe pieces that will be required. (If you intend to bend pipe, review pipe bending or include pipe bending unit here.)
   C. Remind students that they will have to allow for fitting dimensions on both ends of both long and short pieces.

II. Students fabricate the coil bundle for a heat exchanger.

METAL

CONTENT TITLE: Flanges

SUB OBJECTIVE 6: The student will demonstrate ability to fabricate a flat-faced flange.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating a flat-faced flange.

A. Strike center line.
B. Strike center point of flange with center punch.
C. Scribe outside diameter, bolt ring and inside diameter with a pair of dividers.
D. Mark position for first bolt hole. Set dividers equal to length of chord which must be intersected to equally space the appropriate number of holes. To calculate this distance (full chord length), do as follows:

1. Divide twice the number of holes desired into 360°. This is angle A.
2. Take the sine of angle A (this number available from the trigonometric tables listed in the "Sources" column) and multiply it by the radius of the bolt hole circle.
3. Multiply the resultant figure by 2. This is the straight line distance between the bolt holes. The formula is as follows:
   $D = 2(\text{sine } A \times r)$ where:

   D = straight line distance
   $A = 360^{\circ}/2n$
   n = number of holes
   r = radius of bolt hole circle.

4. To find centerline for first hole, divide chord in half and use this distance for positioning first hole. All other holes will be a full chord apart.

Continued...

CONTENT TITLE: Flanges (Continued)

SUB OBJECTIVE 6: The student will demonstrate ability to fabricate a flat-faced flange.

SUGGESTED ACTIVITIES: (Students and Teachers)

E. If no trigonometric tables are available, there is an alternate method.

1. Multiply diameter of bolt hole circle by π (3.1416) and divide by the number of holes. This is roughly equal to the distance calculated in C above. (Accuracy improves with increasing number of holes; it is very rough for 4-hole layouts.)
2. Set dividers for slightly less than this distance and lightly scribe off the bolt hole positions. If last and first bolt hole positions come out short, shorten divider setting and try again. If they come out too far apart, lengthen the divider setting. Continue until you can scribe all the holes equidistant from each other.

F. Cut out flange, set and drill bolt holes (1/2" larger than required bolt size). If you must make more than one, use this flange as a template.

II. Students fabricate a flange.

METAL

CONTENT TITLE: Flanges

SUB OBJECTIVE 7: The student will demonstrate ability to correctly interpret pipe flange specification figures and to mount a flange on a pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses interpreting pipe flange specification data.

A. Discuss sizing data. Point out that first number specifies diameter of pipe flange is designed to fit; second number specifies outside diameter of flange.

B. Discuss series numbers. Point out that the series number, when multiplied by 10, gives the service or pressure rating of the flange.

C. Give students some samples. For instance a 4 x 9 series 15 flange is a 9" diameter flange designed for a 4" pipe. It will withstand service pressures of 150 psi.

D. Discuss selecting gaskets. Mention that on flat-faced flanges, full faced gaskets are normally used; on raised face flanges, the gasket is normally sized to the inside of the bolt ring.

II. Instructor demonstrates mounting a flange on the end of a pipe.

A. Position flange flush with end of pipe, centering as accurately as possible "by eye".

B. Hold a carpenter's level (or spirit level) with top edge contiguous to bottom of top two holes.

Note: This procedure is used in all flange mounting operations with the exception of 12-hole flanges mounted on a 45° angle.

Continued...

METAL

CONTENT TITLE: Flanges (Continued)

SUB OBJECTIVE 7: The student will demonstrate ability to correctly interpret pipe flange specification figures and to mount a flange on a pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

C. Adjust flange and level until top two holes are level and flange is as nearly centered as possible. Lightly tack-weld connection at top.

D. Center tongue of a square on face of flange. Align blade of square along top of pipe. Adjust flange position until blade of square is exactly parallel to pipe. Bottom of connection may be tack-welded at this point or tack welding may be done later. Most pipefitters lightly tack-weld the flange (at bottom of connection) at this stage of the operations.

E. Rotate pipe if possible or turn square to check for parallel along an axis 90° off the previous one. Adjust flange until blade of square is parallel to pipe in all axes. Tack both sides and double check to ensure that nothing has moved and that flange is correctly centered.

III. Students practice interpreting pipe flange specification data.

IV. Students practice mounting pipe flanges on pipe.

METAL

CONTENT TITLE: Gaskets

SUB OBJECTIVE 8: The student will demonstrate ability to fabricate gaskets.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and fabricating gaskets.

   A. Scribe outside diameter using dividers.
   B. Scribe inside diameter using dividers.
   C. Locate holes (if any) or lines to be cut. Cut with snips or a knife. Knock out holes with a ball peen hammer or cut with snips or a knife.

II. Students fabricate gaskets.

METAL

CONTENT TITLE: Bull Plugs and Tee

SUB OBJECTIVE 9: The student will demonstrate ability to lay out and fabricate a bull plug and/or a tee.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out a bull plug and/or a tee.

A. Determine O.D. of pipe.

B. Using a wrap-around, circumscribe a line around the pipe, half the O.D. of the pipe, from the end of the pipe.

C. Quarter the pipe and scribe quarter lines along its length to intersect with the first line (from step B, above). To quarter pipe, wrap a strip of paper around the pipe and cut off all paper overlapping. Fold paper into quarters and wrap around the pipe again. Mark pipe with a soapstone at each of the creases and at the point where the two ends meet.

D. Position wrap-around on pipe like a horseshoe and line up neck of "horseshoe" on top of pipe, centered on the top quarter line and at the end of the pipe. Line up sides of "horseshoe" on the side quarter lines at the point of intersection of those lines with the first circumscribed line ("depth line").

E. Mark the top half of the cut line with a soapstone pencil using the wrap-around as a guide.

F. Turn the pipe over and repeat for the other side of the cut line.

G. To make the plug, take a piece of pipe, similar to the pipe to be plugged, and scribe three lines around it using the wrap-around. The first line should be a centerline. The other two lines should be spaced on either side, half the O.D. of the pipe distance from the first line. Quarter the pipe and mark.

Continued...

CONTENT TITLE: Bull Plugs and Tees (Continued)

SUB OBJECTIVE 9: The student will demonstrate ability to lay out and fabricate a bull plug and/or a tee.

SUGGESTED ACTIVITIES: (Students and Teachers)

H. Position the wrap-around as before, from the top quarter line's intersecting points of the side quarter lines with the middle circumscribed line. Mark cutting line.

I. Repeat, working from the last circumscribed line's intersection with the top quarter line down to the middle line's intersection with the side quarter lines.

J. Use a cutting torch and make a bevel cut to remove the marked piece of pipe. Position this pipe over end of pipe previously cut and tack-weld. Finish weld to complete bull plug.

K. Explain that a tee is fabricated similarly, except that the pipe with the hole is the header; the pipe formerly to be plugged is the branch.

II. Students lay out and fabricate a bull plug and/or a tee.

METAL

CONTENT TITLE: Reducing Tees

SUB OBJECTIVE 10: The student will demonstrate ability to lay out and fabricate a reducing tee.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out the header for a reducing tee.

A. Locate the fitting line on the header.
B. Position branch perpendicular to header and centered over fitting line.
C. Hold a soapstone pencil, sharpened like a chisel, point edge against the branch and scribe a line on the header by drawing soapstone around the branch pipe.
D. From the point where the line thus drawn intersects the fitting line, mark off an additional point outside the circle at a distance equal to the thickness of the wall of the header. Do this at both points.
E. Connect these new points with the circle (at the top of the pipe) freehand with a smooth steady line. This is the cut line.

II. Instructor demonstrates laying out branch for a chisel.

A. Cut a straight piece of wood to a point, like a chisel.
B. Position branch perpendicular to header as before.
C. Position wood against branch as soapstone was positioned before, with point resting on the intersection described in (D) above, but on a different section of pipe.
D. Mark off distance between header and branch on wood stake.
E. Position soapstone on mark; draw the stake and stone around the header. As the stake rides up and down around the header, the stone will mark and cut line on the branch.
F. Mention that, if possible, the branch may be positioned in the hole in the header and the cut line scribed by tracing around the edge of the hole.
G. Position branch and header together and weld.

III. Students lay out and fabricate a reducing tee.

METAL

CONTENT TITLE: Tee and Elbow Specifications

SUB OBJECTIVE II: The student will demonstrate ability to correctly interpret tee and elbow specification figures to mount 90° elbows and tees on pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses tee and elbow terminology.

A. Mention that standard tube turns are accomplished at a rate of 1-1/2 times the diameter of the pipe. For example, a 4" pipe will absorb 6" in a turn and a 6" pipe, 9" in the turn.

B. Mention that short radius tube turns go at the rate of the diameter of the pipe; i.e., a 6" pipe on a short radius will turn in 6".

C. Discuss methods of describing nipples, bolts, stud bolts and other related hardware; i.e., nipples, bolts and stud bolts are specified first by diameter, then by length. For example, a 2 x 6 nipple is 2" in diameter, 6" long.

D. Discuss methods of describing tees, crosses, etc.; i.e., the diameters of the openings are described sequentially, one for each opening. For example, a 2 x 2 x 2-1/2 tee would be a tee with two 2" openings and one 2-1/2" opening. A 2 x 2 x 1-1/2 x 1-1/2 cross would be a cross with two 2" openings and two 1-1/2" openings.

II. Instructor demonstrates aligning 90° elbows and tees with and attaching them to pipe.

A. Position fitting against pipe and align accurately. Allow for welding gap by positioning a hacksaw blade between pipe and fitting if you like. Tack top of joint, lightly.

B. Center the blade of a square along the top of the pipe.

C. Center a second square (blade side) on the face of the elbow or tee and align tongue-to-tongue if possible.

D. Adjust elbow or tee until the two squares may be accurately aligned. Tack bottom and sides of elbow or tee.

III. Students attach 90° elbows and tees to pipe.

METAL

CONTENT TITLE: Heat Exchangers

SUB OBJECTIVE 12: The student will demonstrate ability to fabricate the water jacket and attaching parts for a heat exchanger.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates or outlines task of fabricating a water jacket for a heat exchanger.

   A. Lay out and fabricate bull plug on long end.
   B. Lay out and fabricate a bull plug for short end.
   C. Lay out and cut holes for 2" black steel couplings; likewise, prepare hole for 3" threadolet.
   D. Fabricate 1/4" steel divider plate and weld into head and sides of short pipe.
   E. Assemble and weld into position 3" threadolet and all couplings.
   F. Align gasket, install bolts and bolt two ends of exchanger together.
   G. Fabricate stand, position exchanger and weld into position.

II. Students assemble water jacket and attach parts for a heat exchanger.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to fabricate the parts for and to assemble a boiler.

SOURCES OF INFORMATION

NOTE: Little new is to be learned in the fabrication of a boiler; in fact, the instructor may feel that the likelihood of a student's ever having to fabricate a boiler on site is so slight that an exercise of this sort is of relatively little value. Although this is true, it should be noted that many of the previously learned skills are repeated here and repeated many times. Fabricating a boiler will, therefore, give the student much opportunity to practice many of the skills that will be required to exercise in the field. This exercise, then, is included primarily for its value as a practice exercise; certainly, if the instructor feels that this practice would be better gained in other ways, then they should be used.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Gauge interpolation
- Pressure measurement

Science

- Boilers and heat exchangers
- Water piping systems
- Valves and gauges

Communication Skills

- Student Resource Manual
- Blueprint interpretation
- Symbols

METAL

CONTENT TITLE: Boilers

SUB OBJECTIVE I3: The student will demonstrate ability to fabricate the parts of a boiler.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses project, displays working drawings and outlines the task.

   A. Discuss layout and fabrication of steam header.
   B. Discuss layout and fabrication of water header.
   C. Discuss layout and fabrication of water-wall header. Discuss purpose of water-wall.
   D. Discuss layout, components and fabrication of lower 6" header.
   E. Display drawings and demonstrate bending A, B and C-tubes.
   F. Display drawings for and demonstrate fabricating parts for the casing. Include discussion of working with channel iron and angle iron. Discuss layout and fabrication of the rests for the 6" headers, the casing supports and the casing braces.

II. Students fabricate parts for a boiler.

METAL

CONTENT TITLE: Boilers

SUB OBJECTIVE 14: The student will demonstrate ability to assemble a boiler. When completed, the boiler shall be leak free and shall operate in a satisfactory manner, being free from excessive hot spots, irregular operating characteristics, etc.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses steps in fabricating a boiler.

A. Discuss the fact that it will be necessary to fabricate the boiler in such a manner as to allow most convenient access to working areas at all times, i.e., it will be better to work from inside components outwards.

B. Introduce the concept of subassemblies if desired; i.e., the water-wall may be considered a subassembly. Likewise, the A tube, B tube, etc. assemblies may be so considered.

C. Outline the most convenient steps to fabricating the boiler.

1. Assemble water-wall header and C-tubes.
2. Attach B-tubes and A-tubes to water header.
3. Attach water header to water-wall headers.
4. Attach all tubes to lower 6" water header.
5. Align and attach flanges and supply pipes to water header.
6. Align and attach flanges and feed pipes to steam header.
7. Attach steam header to water header.
8. Install all drains, supply lines, etc. to appropriate headers.
9. Position boiler tube assemblies on casing supports and rests.
10. Attach required casing braces.
11. Apply casing walls, etc.

II. Students fabricate a water boiler.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to perform basic pipefitting operations. These operations should include mounting fittings or flanges on 45° angles, laying out and fitting pipe turns for large diameter pipes and calculating, laying out and fitting single and multiple pipe offsets for any angle. In addition, demonstrate ability to fabricate and set sleeves (or thimbles) on concrete formwork and to install pipe hangers on slabs preparatory to hanging pipe.

SOURCES OF INFORMATION

Frankland, Thomas W., The Pipe Fitter's and Pipe Welder's Handbook, (Direct orders to: Crowell Collier MacMillan Distribution Center, Front and Brown Streets, Riverside, New Jersey 08075), 1969.

Pipe Fitter's Manual, (Tube Turns Division of Chemetron Co.: Louisville, Kentucky 40201).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Using math tables
- Applied trigonometry

Communication Skills

- Related safety
  - Welding and cutting of metals
- Student Resource Manual

METAL

CONTENT TITLE: Offsets

SUB OBJECTIVE 15: The student will demonstrate ability to calculate, lay out and fit up single pipe offsets.

SUGGESTED ACTIVITIES: (Students and Teachers)

1. Instructor discusses calculating pipe offsets.

   A. Mention that most pipefitters have many of the more common constants necessary for calculating various offsets memorized, but that it will be sufficient for the beginning student to learn their derivations and be able to look them up in tables of trigonometric functions.

   B. Identify terms of single offsets; i.e., set, run and travel.

   C. Discuss finding set, run or travel when either of the other variables are known. In the table below, S = Set, T = Travel, R = Run and a = angle of offset.

      1. To find S when T is known, multiply T by Sine of a.
         To find S when R is known, multiply R by Tan of a.
      2. To find R when T is known, multiply R by Cos of a.
         To find R when S is known, multiply S by Cot of a.
      3. To find T when R is known, multiply R by Sec of a.
         To find T when S is known, multiply S by Csec of a.

   D. Discuss selecting angles of offsets to minimize obstruction of space by piping.

Continued...

METAL

CONTENT TITLE: Offsets (Continued)

SUB OBJECTIVE 15: The student will demonstrate ability to calculate, lay out and fit up single pipe offsets.

SUGGESTED ACTIVITIES: (Students and Teachers)

II. Instructor demonstrates calculating, laying out and fitting up a single pipe offset.

A. Select offset and appropriate fittings for diameter of pipe used.
B. Calculate set, run and travel required for offset.
C. Measure, cut and thread incoming and outgoing pipe. Use standard threading on all pipe, preferably so that each pipe will make up 5/8" with fittings.
D. Assemble offset, ensuring that pipe runs level.

III. Students calculate, lay out and fit up a single pipe offset.

METAL

CONTENT TITLE: Offsets

SUB OBJECTIVE I6: The student will demonstrate ability to calculate, lay out and fit up multiple pipe offsets.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses multiple pipe offset calculations.

A. Review calculating travel, set and run of offset.
B. Discuss laying out offsets so that all pipes are parallel and equidistant. Mention that although most experienced pipefitters have constants memorized for calculating the "spread," the beginning student may simply remember that the length of the "spread" may be obtained by multiplying the distance between the pipes (spacing) by the tangent of half of the offset angle.

II. Instructor demonstrates calculating, laying out and fitting up a standard multiple pipe offset.

A. Select offset and appropriate fittings.
B. Calculate set, run and travel for first pipe.
C. Calculate "spread" for second pipe; set, run and travel remain the same.
D. Measure, cut and thread incoming and outgoing pipe for first pipe.
E. Measure, cut and thread incoming and outgoing pipe for second pipe. Add spread factor to second pipe. If more than two pipes are used, add spread to each succeeding pipe from the pipe preceding it.
F. Measure, cut and thread travel pipes; travel is the same for all travel pipes in a multiple pipe offset.
G. Assemble offset, ensuring that all pipes run level and true to each other.

III. Students calculate, lay out and fit up a multiple pipe offset.

CONTENT TITLE: Mounting Fittings

SUB OBJECTIVE 17: The student will demonstrate ability to mount fittings or flanges on a 45° angle.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates mounting flange or fitting on a 45° angle.

A. Align the tongue of a square along the length of pipe to which the fitting or flange is to be affixed. We will call this the first square.

B. With help from an assistant, align a second square such that the blade and tongue cross the blade of the first square. The same numbers on the scale of the tilted square should cross the blade of the first square. The second square will now be 45° relative to the first square.

C. You, or the assistant, may now position the flange, elbow, fitting, etc. abutting one side against the pipe and snugging the other against the edge of the second square. Some adjustment of the squares may be necessary to achieve this fit.

D. Tack-weld the flange, fitting, elbow, etc., to the pipe. Note: If a 45° spirit level is available, it may be positioned on the face of the fitting and aligned that way.

II. Students mount fittings, elbows, flanges, etc., on a 45° angle.

CONTENT TITLE: Pipe Turns

SUB OBJECTIVE 18: The student will demonstrate ability to lay out pipe turns and to cut pipe preparatory to welding the turns.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates using pipe layout tools.

A. Demonstrate quartering pipe. To quarter pipe, wrap a strip of paper around the pipe and cut off all paper overlapping. Fold paper into quarters and wrap around the pipe again. Mark pipe with a soapstone at each of the creases and at the point where the two ends meet.

B. Demonstrate using the wraparound to mark a cutting line. Mention that wraparound must be large enough to overlap some to ensure that cutting lines will be straight and true.

II. Instructor demonstrates calculating layout for a pipe turn.

A. Determine angle of cut. Do this by dividing the turn angle by the number of welds multiplied by 2. E.g., the angle of cut for a three-piece, 90° turn would be (number of welds = 2):

$$\frac{90^{\circ}}{2 \times 2} = \frac{90^{\circ}}{4} = 22.5^{\circ}$$

B. Determine start and finish lines of cut. To determine these dimensions, multiply the O.D. of the pipe by the tangent of the cut angle and divide by 2. For the above turn on a 3" pipe 3.5" (O.D.), the start and finish lines of the cuts would be:

$$\frac{3.5 \times 0.414}{2} = 0.725'' \text{ or approximately } 23/32''.$$

Continued...

CONTENT TITLE: Pipe Turns (Continued)

SUB OBJECTIVE 18: The student will demonstrate ability to lay out pipe turns and to cut pipe preparatory to welding the turns.

SUGGESTED ACTIVITIES: (Students and Teachers)

C. Demonstrate calculating length of cut piece for incoming pipe. Mention that this is the length as measured from the tangent line of the turn angle to the first fitting centerline. The length is found by multiplying the radius times the tangent of the angle of cut. Length of remaining pieces is twice this figure. On our 3" pipe (assuming a 3" radius) the lengths would be: tan $22\text{-}1/2^{\circ} = 0.414$; $0.414 \times 3 = 1.243$" or 1-1/4"; remaining pieces = $1.243 \times 2 = 2.486$" or 2-1/2".

III. Instructor demonstrates laying out the cut for a pipe turn.

A. Quarter pipe and mark quarter lines along length of pipe to be cut.
B. Mark centerline of fitting with a wraparound and soapstone pencil.
C. Determine angle of cut required as above.
D. Determine distance between start and finish lines and fitting centerline.
E. Locate start line at top of pipe, and using a wraparound, mark this line all the way around the pipe. Do the same for the finish line.
F. Position wraparound on pipe like a horseshoe and line up neck of "horseshoe" on top of pipe at start line. Line up sides of wraparound with points where fitting centerline intersects the lines on the sides (lines indicating quarters of pipe).
G. Mark the cut line on the top half of the pipe using a soapstone and using the wraparound as a guide.
H. Turn pipe over and repeat to complete the cut line.

Continued...

CONTENT TITLE: Pipe Turns (Continued)

SUB OBJECTIVE 18: The student will demonstrate ability to lay out pipe turns and to cut pipe preparatory to welding the turns.

SUGGESTED ACTIVITIES: (Students and Teachers)

IV. Instructor demonstrates making a three-piece 90° turn on 3" pipe with a 3" radius.

A. Determine angle of cut.
B. Determine length of pieces.
C. Quarter pipe and mark off "quarterlines." Measure and mark off fitting centerlines.
D. Calculate positions of start and finish lines for cuts and mark these on pipe using a wraparound as a guide.
E. Mark top of cut lines using wraparound; turn pipe over and finish marking cut lines.
F. Use a cutting torch (make a bevel cut) to cut pipe along indicated guidelines.
G. Square cut pieces with each other and tack-weld into position.

V. Students make a three-piece 90° turn on 3" pipe with a 3" radius.

METAL

CONTENT TITLE: Thimbles

SUB OBJECTIVE 19: The student will demonstrate ability to set sleeves (or thimbles) on concrete formwork.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses making thimbles for concrete formwork.

A. Discuss materials sleeves are made of, such as 24 gauge sheetmetal or pipe.
B. Discuss sizing of sleeves, mentioning that most are at least 1" larger than the pipe they will accommodate.
C. Mention that sleeve should be somewhat longer than the thickness of the concrete it is running through. Usually, they are 3" longer than slab thickness.

II. Instructor demonstrates fabricating and setting sleeves.

A. Measure, lay out, cut and roll sheetmetal (if necessary) to form a cylinder of the required length and diameter.
B. Cut or snip parallel cuts along the axis of the pipe every 3/4" or so and about 1-1/2" deep all around the pipe.
C. Bend strips out to form a "top-hat".
D. Locate, position and nail sleeve down to concrete form.
E. Fill sleeve with loose sand. (Some people prefer wadded newspaper.)
F. Mention that sand or paper will keep concrete people from filling sleeve with concrete. Mention also that if it is undesirable for the sleeve to remain in the concrete, it may be coated with a release compound before the concrete is poured and removed with the forms.

III. Students fabricate and set sleeves on concrete forms.

METAL

CONTENT TITLE: Pipe Hanger Installation

SUB OBJECTIVE 20: The student will demonstrate ability to install pipe hangers on wood decking (concrete formwork) before concrete is poured.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing pipe hangers in concrete slabs.

A. Measure, locate and mark hanger positions on deck.
B. Nail insert to decking using tabs supplied. Some inserts nail from the top, others from the bottom.
C. After forms are wrecked, clean insert of concrete if necessary.
D. Insert nut in insert.
E. Cut to size and thread round rod (if necessary) or use pre-fabricated rod. Screw rod into nut in insert.
F. Attach socket eye to rod.
G. Attach split ring pipe hanger to rod. Screw down nut and bolt after pipe is installed.

II. Students install pipe hangers in concrete slabs.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to fabricate a complete steam and hot water heating system.

SOURCES OF INFORMATION

None

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Level and plumb
- ID and OD
- Temperature measurement
- Pressure measurement
- General review of math requirements for job entry

Science

- Hot water and steam systems
- Condensation
- Valves and gates (manual and automatic)
- Pump theory and operation
- General review of science requirements for job entry

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- General review of communication skill requirements for job entry
- Review of post-secondary education opportunities
- Apprenticeship programs
- Looking for, getting and holding a job

METAL

CONTENT TITLE: Condensate Return System

SUB OBJECTIVE 21: The student will demonstrate ability to hook up the condensate return lines in a hot water heating system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses condensate return system.

A. Mention that all condensed steam is gathered and returned to the boiler.
B. Discuss operation of traps and procedures that must be observed during mounting.
C. Discuss operation of condensate tank and condensate return pump.

II. Students hook up the condensate return lines in a hot water heating system.

CONTENT TITLE: Water Feed Lines

SUB OBJECTIVE 22: The student will demonstrate ability to install the water feed lines.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses water feed lines and legally required safety precautions to be observed when hooking into domestic water lines.

A. Discuss importance of installing check valves to prevent backflow into water supply lines. Check valves must be installed in all loops which, either under normal operation or draining or blowdown operations, might feed water back into domestic supply lines.
B. Discuss use of various valves and operations involved in blowdown.

II. Students install the water feed lines to a hot water heating system.

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METAL

CONTENT TITLE: Boiler Connections

SUB OBJECTIVE 23: The student will demonstrate ability to hook up all external boiler connections.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses external boiler connections, principles regarding some of these boiler connections and the reasons for most of them.

   A. Discuss purpose and operation of the water glass. Discuss mounting procedures and need for care in installing the water glass.
   B. Discuss operation, purpose and installation of the automatic water feed, low water cutoff and pump starter.
   C. Discuss problems of scale buildup and necessity for regular drainage and blowdown of boiler equipment. Indicate points where drains and blowdowns must be provided. Mention legal aspects of some of these items.

II. Students hook up external boiler connections.

METAL

CONTENT TITLE: Main Steam Lines

SUB OBJECTIVE 24: The student will demonstrate ability to connect the main steam lines to the boiler.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses connecting main steam lines to boilers.

A. Discuss operation of steam gauges and reasons for pigtails (they fill with water and prevent live steam from hitting the gauge).
B. Discuss need for installing gate valve for future equipment. (Building may require air conditioning later and an absorption machine may be run off steam from the boiler.)
C. Discuss need for gate valve to heat exchanger.
D. Discuss operation of reducing valves and the need for a valve in this installation.
E. Discuss operation of automatic steam control valves.

II. Students connect main steam lines to boilers.

METAL

CONTENT TITLE: Moving Heavy Objects

SUB OBJECTIVE 25: The student will demonstrate ability to move extremely heavy equipment, safely, using steel rails.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses problems of moving extremely heavy equipment using steel rails.

A. Mention that a determination must be made as to the weight carrying capacity of the floor. If the floor will not support such weight (this includes all the floor from the point of the equipment's delivery to the point of installation) other means of transporting the equipment must be made, such as dismantling.

B. Discuss moving equipment over grades. Mention that very small grades may be handled while using the rail method by building temporary concrete "ramps" to support the rails. Otherwise, it will be necessary to use cribbing methods to raise equipment to next floor level and new rails will have to be laid on the new grade.

C. Demonstrate positioning the rails.

D. Demonstrate greasing the rails and positioning equipment on rails.

E. Demonstrate hooking up equipment to hoists, pulleys, etc. Emphasize that the method requires constant attention to ensure that equipment is not pulled off the rails.

II. Students move heavy equipment using rails.

METAL

CONTENT TITLE: Securing Machinery

SUB OBJECTIVE 26: The student will demonstrate ability to secure heavy equipment to mounting pads.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates securing heavy equipment to mounting pads.

   A. Discuss necessity for all equipment to be level and plumb "with the world".
   B. Demonstrate methods of leveling and plumbing large, bulky items of machinery.
   C. Demonstrate using Phillips shields. To use the Phillips shield, obtain special tool and insert tool in shield. Drive plug into concrete. Remove tool and clean out opening. Then install bolt; the bolt expands in the plug forming a very secure fit.

II. Students secure heavy equipment to mounting pads.

METAL

CONTENT TITLE: Hanging Pipe

SUB OBJECTIVE 27: The student will demonstrate ability to set hanging pipe at a given rise.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses various methods of hanging pipe to a specified rise.

A. Discuss technique of floor to ceiling height measurements, using pipe rack. Mention that this method assumes a level floor.

B. Discuss techniques of measuring from ceiling to bottom of pipe hanger. Mention that this technique is the most popular and assumes a level ceiling.

C. Discuss methods of hanging pipe to a line (much as a bricklayer lays brick to a line). In this method, neither floor nor ceiling are assumed to be level. A line is stretched along the path of the pipe and is leveled or set to the desired rise after leveling. This method assumes that a stretched line is straight.

D. Mention use of a surveyor's transit in setting pipe on a grade. If it is desired that this method be used, it will be necessary to instruct students in the use of the transit. See USOE curriculum guides on SURVEYING or HEAVY EQUIPMENT OPERATION.

II. Students hang pipe to a line.

METAL

CONTENT TITLE: Hot Water Supply

SUB OBJECTIVE 28: The student will demonstrate ability to run hot water supply line for a hot water heating system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses running hot water supply lines.

A. Discuss connection of seat and steam control valve capillary.
B. Discuss operation of Automatic Air Vent (AAV).
C. Emphasize importance of observing correct elevation of pipe throughout the run. On systems without pumps (gravity feed systems) this is particularly important. Failure to do so will result in complete operational failure of the system.
D. Discuss importance of being able to check operating temperature of fluids inside pipes. Outline installation procedures for thermometer wells.

II. Students run the hot water supply line for a hot water heating system.

METAL

CONTENT TITLE: Hot Water Return

SUB OBJECTIVE 29: The student will demonstrate ability to run the hot water return line for a hot water heating system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses running hot water return lines.

A. Discuss operation of pump. Mention types of pumps most frequently used and necessary precautions to observe when hooking them up.

B. Discuss similar systems which do not use pumps. Emphasize necessity in these systems for accurate observations of grade lines. Incorrect grading will result in a completely non-operational system.

C. Discuss need for an expansion tank. Illustrate with possible operational parameters, such as normal pumping pressure limits of 100 to 200 pounds -- pressure as high as several thousand pounds caused by heating media in confined areas.

II. Students run the return line for a hot water heating system.

METAL

CONTENT TITLE: Hot Water Heating Coils

SUB OBJECTIVE 30: The student will demonstrate ability to hang hot water heating coils.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing heater coils in ceiling.

A. Install hangers in previously mounted mounting sockets.
B. Connect three rods to ceiling.
C. Connect trapeze to rods.
D. Lift and position coil on trapeze, supporting remaining corner where necessary.
E. Connect last rod to ceiling and trapeze. Level trapeze and make any necessary adjustments to make trapeze "square with the building".

II. Students hang heater coils in the ceiling.

METAL

CONTENT TITLE: Hot Water Heating Coils

SUB OBJECTIVE 3I: The student will demonstrate ability to connect hot water heating coils.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses operation of hot water heating coils and demonstrates their installation.

   A. Discuss advantages and disadvantages of hot water heating coils.
   B. Demonstrate fabricating special header. Be sure to install AAV's and thermometer wells. Discuss preference for using this type of connector over bushings (this type of header eliminates possibility of entraining air). It is almost impossible to avoid air entrainment using bushings, etc. and system does not work well with air in the lines.
   C. Discuss installation of stop cocks, installation and operation of 3-way valves and automatic valves.

II. Students connect hot water heating coils.

METAL

CONTENT TITLE: Steam Pre-heat Coils

SUB OBJECTIVE 32: The student will demonstrate ability to connect a steam pre-heat coil.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses applications of steam pre-heat coils and considerations of running live steam lines.

   A. Mention that in many very cold regions and in installations where fresh air is supplied to the system at all times (such as in hospitals), very cold air may freeze water in hot water coils. The steam pre-heat coils elevate the temperature of the incoming air and prevent this from happening.
   B. Discuss installation of pneumatically-controlled equipment. Tailor discussion to the equipment to be used and derive information from manufacturer's recommendations.
   C. Discuss installation and operation of bucket steam traps.

II. Students connect steam pre-heat coils.

METAL

CONTENT TITLE: Electrical Components

SUB OBJECTIVE 33: The student will demonstrate ability to connect the electrical components as well as the fragile components of a hot water heating system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation of fragile components and electrically operated items in a hot water heating system.

   A. Discuss operation of capillary tubes and the need for care in handling them.
   B. Discuss operation of pneumatic devices and the need for care in running pneumatic air lines.
   C. Discuss operation of pigtails and their fabrication.
   D. Demonstrate care and handling of glass thermometers.
   E. Discuss connecting electrical components according to manufacturer's recommendations. Any error here will usually render a portion of the system operation inoperable. Also emphasize the fact that all electrical soldering must be done with a non-acid core flux. Connections must be clean and free of all acid. Otherwise, corrosion and call backs are inevitable.

II. Students connect fragile components and electrically operated components in a hot water heating system.

AIR CONDITIONING AND HEATING

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METAL

OVERALL OBJECTIVE: The student will demonstrate ability to cut, bend and fasten copper tubing.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and A. F. Bracciano, Modern Refrigeration and Air Conditioning, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material sizing

Science

Solders and fluxes

Communication Skills

- Manufacturer's literature
- Related safety information
  - Use of torches
  - Use of cutting and threading tools
- Student Resource Manual

METAL

CONTENT TITLE: Pipe

SUB OBJECTIVE 1: The student will demonstrate ability to cut and bend, with a spring bender, small copper tubing.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and connects the components of a refrigeration system.

   A. Discuss order in which components are connected with regard to functional relationships.
   B. Discuss the names of pipes in a refrigeration system.

II. Instructor demonstrates bending small copper tubing.

   A. Unroll soft copper tubing.
   B. Use tube cutter.
   C. Measure length and cut.
   D. Slip tubing into spring.
   E. Bend slightly in excess of required bend.
   F. Pull tubing back to required bend.
   G. Remove spring.

III. Student cuts and bends soft copper tubing.

CONTENT TITLE: Pipe

SUB OBJECTIVE 2: The student will demonstrate ability to join copper tubing with silver solder.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates joining copper tubing with silver solder.

A. Swage on end of tubing.
B. Clean ends of tubing and join together.
C. Apply flux to joint, if required.
D. Heat joint with torch.
E. Apply silver solder.

II. Student joins copper pipe with silver solder.

CONTENT TITLE: Pipe

SUB OBJECTIVE 3: The student will demonstrate ability to ream pipe using a spiral reamer.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces the spiral reamer.

A. Explain and discuss types of reamers.
B. Explain how spiral reamer works.
C. Note that nearly all pipe operations require reaming.

II. Instructor demonstrates reaming of pipe.

A. Secure pipe in a vise.
B. Pick up reamer grasping long handle in dominant hand and short handle in other hand.
C. Insert spiral tapered end in pipe and ream.

III. Students ream a pipe with the spiral reamer.

METAL

CONTENT TITLE: Pipe

SUB OBJECTIVE 4: The student will demonstrate ability to cut steel and copper pipe with a single wheel cutter.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses types and styles of binders.

II. Instructor demonstrates how to cut steel pipe with single wheel cutter.

A. Select, measure and mark pipe to be cut.
B. Mount pipe in vise with shortest pieces protruding about 6".
C. Position cutters under pipe and raise cutter to engage pipe.
D. Close cutter and ensure that both guide wheels are in contact with pipe.
E. Tighten cutter very lightly and make a ring on the pipe by turning cutter one revolution (full round).
F. Ensure that cutter wheel tracks.
G. Tighten "T" handle one quarter turn and move cutter back and forward, making a deeper ring around the pipe.
H. Continue turning "T" handle one quarter turn and moving forward and back around pipe until the pipe gives. Tighten slightly more and remove the pipe. (Hold on to piece of pipe protruding from vise so that no one gets hurt when it drops.)

III. Students cut a piece of steel pipe.

METAL

CONTENT TITLE: Pipe

SUB OBJECTIVE 5: The student will demonstrate ability to thread pipe using ratchet dies.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. The instructor demonstrates cutting a pipe thread with a ratchet die.

   A. Select measured, cut and reamed piece of pipe.
   B. Mount pipe in vise.
   C. Pick up die with long handle in dominant hand and guide die onto pipe with other hand.
   D. Apply pressure to face of die and start threads.
   E. Alternately oil dies and advance threading tool until one thread extends beyond dies.
   F. Remove die and clean.

II. Student threads a steel pipe with a ratchet die.

METAL

OVERALL OBJECTIVE: • The student will demonstrate ability to mount and vent a natural gas furnace and to install ductwork, connect electrical and gas connections and perform an operational check on the furnace.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and A. F. Bracciano, Modern Refrigeration and Air Conditioning, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1968.

Flint, Kendall H., "A Practical Guide to Installing Gas Vents," American Artisan, Vol. 100, No. 12 (December, 1963), pp. 32-36.

Flint, Kendall H., "Tables Ease, Speed Task of Sizing Gas Venting Systems," American Artisan, Vol. 101, No. 1 (January, 1964), pp. 67-73.

Flint, Kendall H., "What You Should Know About Gas Venting," American Artisan, Vol. 100, No. 11 (November, 1963), pp. 32-37.

Continued...

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to mount and vent a natural gas furnace and to install ductwork, connect electrical and gas connections and perform an operational check on the furnace.

(Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring and layout
- Material sizing
- Interpretation of dials and gauges

Science

- Use of vents and flues
- BTU explanation
- Blowers and ducts
- Heat exchangers
- Air filtration
- Thermostats and safety switches
- Combustion
- Solenoid operation

Communication Skills

- Manufacturer's literature
- Related safety information
  - Moving and placing equipment
  - Installing gas fired equipment
  - Use of ladders
- Building codes
- Other-than-air applications of a gas fired heat center
  - Hot water systems
  - Steam

METAL

CONTENT TITLE: Natural Gas Furnace

SUB OBJECTIVE 6: The student will demonstrate ability to mount the forced convection vertical up flow model furnace in a utility closet with an elevated floor.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses types and locations of natural gas furnaces.

II. Instructor demonstrates installing a natural gas furnace.

A. Unpack equipment.
B. Move equipment to installation area.
C. Locate ceiling joist.
D. Align furnace outlet between ceiling joists.
E. Mark area to be cut for air inlet.
F. Move furnace and ceiling opening.
G. Place furnace over opening and seal furnace to floor.

III. Students mount a furnace.

METAL

CONTENT TITLE: Natural Gas Furnace

SUB OBJECTIVE 7: The student will demonstrate ability to install a vent pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses city or area codes for furnace venting.

II. Instructor demonstrates installation of vent pipe.

A. Use plumb bob to align vent opening of furnace with ceiling and roof opening.
B. Assemble vent pipe.
C. Install and seal roof jack and vent cap.

III. Students install vent pipe, roof jack and cap.

METAL

CONTENT TITLE: Natural Gas Furnaces

SUB OBJECTIVE 8: The student will demonstrate ability to install a duct system using pre-fabricated round ductwork and round ceiling diffusers.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation and operation of the ductwork system.

   A. Discuss plenum chambers and their uses.
   B. Discuss blueprint symbols.
   C. Discuss determination of ductwork sizes.

II. Instructor demonstrates installing a ductwork system.

   A. Assemble duct pipes.
   B. Secure joints.
   C. Support duct pipes.
   D. Install diffusers and dampers.
   E. Install duct pipes.
   F. Install return system.

III. Students install a duct system.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to install and start an oil-burning furnace.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and A. F. Bracciano, Modern Refrigeration and Air Conditioning, (Goodheart-Wilcox Co. Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Unit measurement
  - Square
  - Cubic
  - Pressures

Science

- Pump operation
- Filtration of liquids
- Combustion
- Heat exchange
- Special electrical and mechanical safety devices

Communication Skills

- Manufacturer's literature
- Related safety information
  - Using fuel oils
  - Special pressure and heat safety devices
- Code requirements
- Other-than-air applications of an oil-fired heat center
  - Hot water systems
  - Steam

METAL

CONTENT TITLE: Oil-Burning Furnaces

SUB OBJECTIVE 9: The student will demonstrate ability to install an oil-burner type furnace.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses aspects of oil-burner type furnace installation.

   A. Discuss types of oil-burning furnaces and their operation.
   B. Discuss installation of oil tanks.
   C. Discuss ignition, controls and safety considerations.
   D. Describe and demonstrate test instruments used with oil burning furnaces.
   E. Discuss installation code requirements.

II. Instructor demonstrates installing an oil-burning furnace.

   A. Mount oil tank on mounting legs and secure.
   B. Connect oil-fill pipe from tank to outside of building.
   C. Connect tank air vent pipe to outside of building.
   D. Connect tank shut off valve and strainer.
   E. Connect fuel line from tank to pump inlet.
   F. Connect fuel line from regulator to tank (return line when required).
   G. Install vent pipe for flue gases.
   H. Install warm air and return air duct systems.
   I. Connect electrical power circuits and thermostatic control circuits.
   J. Fill tank.

III. Students install an oil-burning furnace.

METAL

CONTENT TITLE: Oil-Burning Furnaces

SUB OBJECTIVE 10: The student will demonstrate ability to start an oil-burning furnace.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates starting an oil-burning furnace.

A. Check ignition system operation.
B. Install pressure gauge to oil pump.
C. Install stack thermometer.
D. Inspect fire pot; if oil is present, do not start system.
E. Open tank valve and bleed air from lines.
F. Check fuel connections for leaking.
G. Start system.
H. Check color of flame.
I. Check oil pump pressure.
J. Check stack temperature.
K. Make adjustments as necessary.

II. Students start an oil-burning furnace.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to install, connect and verify the correct operation of a residential heating-cooling unit.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and A. F. Bracciano, Modern Refrigeration and Air Conditioning, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Plumb and level
- Dial and gauge interpretation
- Material sizing

Science

- Electrical circuitry
  - 24 volt
  - 115 volt
  - 230 volt
- Transformers
- Thermostats and relays
- Air condition cycle and components
- Leak detection devices

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Related safety information
  - Proper use of refrigerant
  - Electrical hazards

METAL

CONTENT TITLE: Residential Heating-Cooling Systems

SUB OBJECTIVE II: The student will demonstrate ability to install residential heating-cooling systems.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces aspects of central heating and cooling systems.

A. Discuss sub-base color codes. (Red = 24V power into sub-base; White = heating circuit out of sub-base; Yellow = cooling circuit out of sub-base; Green = fan relay coil out of sub-base; and Orange = damper motor out of sub-base.)

B. Discuss other manufacturer's color codes where V= voltage (24V); C = cooling circuit out of sub-base; F = fan circuit; and T = common connection to transformer.

C. Discuss one transformer 24V power supplies and two transformer 24V power supplies.

D. Discuss overall operation of control center.

E. Review operation of natural gas furnace (forced convection).

F. Discuss purpose of fan relay.

G. Show location of thermostat and sub-base.

H. Demonstrate plumbing or leveling of sub-base for calibration.

I. Demonstrate mounting slab for condensing unit prefabricated or placed on location.

J. Demonstrate placement of mounting slab and condensing unit, showing clear of run off from overhang or gutters and discuss prevailing winds considerations (horizontal discharge with wind; vertical discharge-wind no problem, and the noise of discharge air).

K. Demonstrate insulating of suction line.

L. Discuss state license requirements.

M. Discuss coordinating placing of equipment with building contractor.

Continued...

METAL

CONTENT TITLE: Residential Heating-Cooling Systems (Continued)

SUB OBJECTIVE II: The student will demonstrate ability to install residential heating-cooling systems.

SUGGESTED ACTIVITIES: (Students and Teachers)

N. Mention quick coupling connectors and precharged systems.
C. Discuss condensate pumps used in basement installations. Mention discharge check valves and water level safety switches.
P. Describe condensation drain pans and safety drain pans with separate drain pumps used in attic installations.

II. Instructor demonstrates installing a residential heating and cooling unit.

A. Discuss overall function of control center.
B. Plumb or horizontally level sub base.
C. Grade, form and place concrete slab.
D. Place condensing unit.
E. Install quick couplers.
F. Draw overall wiring diagram of unit.
G. Conceal wire and pipes.
H. Provide air and vent air for furnaces.
I. Seal return air.
J. Insulate pipes.

III. Students install a residential heating and cooling unit.

METAL

CONTENT TITLE: Electricity

SUB OBJECTIVE 12: The student will construct an extension station.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses aspects of extension service.

A. Discuss configurations of plugs and receptacles.
B. Identify configurations to their intended voltages.
C. Identify color coding for each connection.
D. Discuss requirements for 115 volts and 230 volts installations.
E. Demonstrate construction of an extension station.

II. Students construct an extension station.

CONTENT TITLE: Electricity

SUB OBJECTIVE 13: The student will design and construct a simple circuit (1 switch SPST, 1 load).

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses simple circuits.

A. Identify components.
B. Discuss power sources, loads (motors, lights, electromagnets, etc.), load direct to power source, load through a switch, a short circuit and requirements for a good circuit such as load switch, pathway switch and power source.

II. Students design and construct a simple circuit.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to design and construct a variety of simple and relatively complex circuits to the end so that the ability to predict the operation of circuits of generically similar design will be acquired.

SOURCES OF INFORMATION

An Introduction to Basic Electricity, (White-Rodgers: Station 1478, 9797 Reavis Road, St. Louis, Missouri).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Material and equipment sizing
- Meter scale interpolation

Science

- Electrical circuitry
  - Hot wire
  - Common or neutral
  - Ground
  - Alternating current
  - Voltage and amperage
  - Continuity
  - Switches and receptacles
  - Parallel and series circuits
  - Relays and transformers

Communication Skills

- Related safety information on electrical wiring hazards
- Student Resource Manual
- National Electrical Code
- Vocabulary development

CONTENT TITLE: Electricity

SUB OBJECTIVE I4: The student will design and construct a circuit with 2 or more switches in series (SPST, I load).

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses series circuits.

   A. Discuss design and operation of series switches.
   B. Discuss application of switches in series.

II. Students design and construct a series circuit.

CONTENT TITLE: Electricity

SUB OBJECTIVE I5: The student will design and construct a circuit with two or more loads connected in parallel and controlled by one SPST switch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses parallel loads.

   A. Mention that loads are always in parallel with other loads.
   B. Note that loads in series with other loads are very rare and used for special applications.
   C. Discuss uses of loads in parallel.

II. Students design and construct a circuit with parallel loads.

CONTENT TITLE: Electricity

SUB OBJECTIVE 16: The student will design and construct a circuit with two or more loads connected in parallel and controlled by two or more SPST switches wired in series.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses parallel loads controlled by series switches.

A. Describe situations in which this type of circuit is used.
B. Describe operation of this circuit.

II. Students design and construct a circuit with parallel loads controlled by series switches.

CONTENT TITLE: Electricity

SUB OBJECTIVE 17: The student will design and construct a circuit with two or more SPST switches in parallel and a load.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses parallel switching.

A. Discuss design and operation of switches in parallel.
B. Discuss application of switches in parallel.

II. Students design and construct a parallel switching circuit.

METAL

CONTENT TITLE: Electricity

SUB OBJECTIVE 18: The student will design and construct a contractor type relay circuit (2 voltage system) with a control switch SPST, SPST n.o. relay (24 volt coil) and a 115 volt load.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses relay control circuit.

A. Discuss operation of relays.
B. Discuss requirements of relay coils, (electro-magnets) (24, 115, 230 volts and amperage draw).
C. Discuss transformer operation.
D. Demonstrate operation of a relay, connection power circuit, connecting control and connecting transformer circuit.

II. Students design and construct the relay control circuit.

METAL

CONTENT TITLE: Electrical Components

SUB OBJECTIVE 19: The student will demonstrate ability to properly connect a single phase motor starter and a motor with a 24 volt control circuit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces connecting single phase motor starters and motors with 24 volt controlled circuits.

   A. Internal circuits of single phase motor starter.
   B. Describe internal circuits of four terminal overload.
   C. Display cut away models of contractor and overload.
   D. Describe control circuit consisting of 115/24 volt transformer, contractor coil and remote SPST hand operated switch.
   E. Illustrate complete wiring diagram of single phase motor starter, motor and control circuit.

II. Students connect a single phase motor starter with a 24 volt control circuit.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to install and connect single and three phase motor starters and potential and current-type starting relays.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and A. F. Bracciano, Modern Refrigeration and Air Conditioning, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Electrical measurement and meters

Science

- Electricity
  - Phasing
  - Relay operation
  - Capacitors
    - Start
    - Run
  - Motor windings
    - Start
    - Run
    - Common

Communication Skills

- Manufacturer's literature
- Vocabulary development
- Related safety information concerning electricity

METAL

CONTENT TITLE: Electrical Components

SUB OBJECTIVE 20: The student will demonstrate ability to properly connect a three phase motor starter and motor to a 230 volt control circuit with 3 SPST switches in series.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates connecting three phase motor starters and related equipment.

   A. Display and discuss complete diagram of three phase power circuit and control circuit.
   B. Discuss three phase power.
   C. Discuss two or more overloads for three phase motors.
   D. Describe notation of three phase motors.
   E. Demonstrate connecting 3 phase motor starter and related components.

II. Students connect a three phase motor starter and motor to 230 volt control circuits with three SPST switches in series.

METAL

CONTENT TITLE: Electrical Component

SUB OBJECTIVE 21: The student will demonstrate ability to properly connect a potential type motor starting relay (3 terminals with 3# terminal overload), a start capacitor, a run capacitor, an air capacitor and an air conditioner control switch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates connecting potential type motor starting relays and related controls.

   A. Discuss internal parts and connection of relay; compare to actual relay.
   B. Discuss internal parts and connection of overload; compare to actual overload.
   C. Demonstrate operation of relay.
   D. Demonstrate operation of overload.
   E. Demonstrate connecting relay.
   F. Illustrate complete wiring diagram of electric system and connection of other components.

II. Students connect potential type motor starting circuits and related controls.

METAL

CONTENT TITLE: Electrical Components

SUB OBJECTIVE 22: The student will demonstrate ability to connect a current type motor starting relay (4 terminals, with 3# terminal overload), a start capacitor, a run capacitor and an air conditioner control switch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces connecting current type motor starting relays.

   A. Illustrate internal parts and connections of relays.
   B. Discuss internal overload devices.
   C. Demonstrate operation of relay.
   D. Demonstrate operation of overload.
   E. Demonstrate operation of start capacitor.
   F. Discuss function of control switch.
   G. Demonstrate connecting components within their circuits, including the run circuits, start circuits, run capacitor circuits and evaporator fan motor.

II. Students connect current type motor starting relays.

METAL

CONTENT TITLE: Electrical Components

SUB OBJECTIVE 23: The student will demonstrate ability to mount and connect the current type relay, overload, start capacitor and switch for a refrigeration system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses electrical components or refrigerators.

A. Describe connections of compress or motor to terminals common, start and run.
B. Discuss purpose and mounting positions of current type motor starting relay.
C. Discuss purpose and operation of overload protector start capacitor and on-off switches.
D. Outline typical connection of refrigeration electrical components. Connecting of components together.
E. Demonstrate identification of compression motor terminals.

II. Instructor demonstrates identifying terminals on compressor and connecting electrical components.

A. Identify terminals on compressor by measuring resistance between each of the three terminals. Disregard higher resistance; of the remaining, the smaller reading is the run winding, the larger is the start winding; start and run winding are connected at common.
B. Connect current type relay.
C. Connect start capacitor.
D. Connect switch.
E. Ohm method of identifying compressor terminals (meter must be of high quality).

III. Student connects electrical components in a typical refrigeration system.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to mount and connect the components of a refrigeration system.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and A. F. Bracciano, Modern Refrigeration and Air Conditioning, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Interpreting pressure gauges

Science

- Refrigerant metering devices
- Refrigerant cycles and components

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Vocabulary development

METAL

CONTENT TITLE: Assembling a Refrigeration System

SUB OBJECTIVE 24: The student will demonstrate ability to mount components of a refrigeration system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses identification and function of refrigeration system components.

II. Instructor demonstrates:

A. Power unit (motor compressor) mounting.
B. Condensor mounting.
C. Evaporator mounting.
D. Metering device mounting.
E. Condensor fan mounting.

III. Students mount components basic to a refrigeration system.

METAL

CONTENT TITLE: Assembling a Refrigeration System

SUB OBJECTIVE 25: The student will demonstrate ability to connect the components for a refrigeration system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses refrigeration cycle and connecting the components.

II. The instructor demonstrates connecting components of refrigeration system.

A. Connect discharge pipe to condensor inlet.
B. Connect condensor outlet to metering device.
C. Connect metering device to evaporator inlet.
D. Connect evaporator outlet to suction pipe.
E. Connect suction and discharge pipes to compressor.
F. Connect electrical components.

III. Students connect up a refrigeration system.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to assemble piping, evacuate and charge a system, check for leaks and connect the electrical components in a refrigeration system.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and A. F. Bracciano, Modern Refrigeration and Air Conditioning, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1968.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Scientific laws covering properties of liquids and gases
- Principle of a vacuum pump
- Review refrigeration cycle and components
- Leak detection techniques

Communication Skills

- Manufacturer's literature
- Related safety information concerning working with refrigerants
- Student Resource Manual

METAL

CONTENT TITLE: Assembling a Refrigeration System

SUB OBJECTIVE 26: The student will demonstrate ability to perform a leak check.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates performing leak checks.

A. Install service valves.
B. Pressurize system using a gauge manifold.
C. Pass leak detector over refrigerator lines, watching for indication of leaks.
D. Demonstrate leak detector (not electric).
E. Discuss handling and use of refrigerant cylinders.
F. Demonstrate repair of leaky connections and rubbed or punctured lines.

II. Students perform a leak check.

METAL

CONTENT TITLE: Assembling a Refrigeration system

SUB OBJECTIVE 27: The student will demonstrate ability to evacuate a refrigeration system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses vacuum pumps, measurement of vacuums, developing vacuums and operation of gauge manifolds.

II. Instructor demonstrates evacuating a refrigeration system.

A. Identify pump inlet and exhaust.
B. Connect vacuum pump to gauge manifold; connect gauge manifold to suction and discharge pipes of refrigeration system.
C. Connect middle hose of manifold to vacuum pump.
D. Open both manifold valves.
E. Start vacuum pump and pull system down to 28" or more. Vacuum pump for 30 minutes.
F. Close manifold valves and disconnect middle hose.
G. Connect middle hose to refrigerant cylinder, purge hose and pressurize system through low side only.
H. Discharge pressure through discharge service valve.
I. Close low and high side manifold valve and connect middle hose to vacuum pump.
J. Open low side and high side manifold valves and repeat E, F, G and H, twice.

III. Students evacuate a refrigeration system.

METAL

CONTENT TITLE: Assembling a Refrigeration System

SUB OBJECTIVE 28: The student will demonstrate ability to charge a refrigeration system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates charging a system.

A. Close both manifold valves and stop vacuum pump.
B. Remove middle hose from vacuum pump and connect to refrigerant cylinder. (Refrigerant determined by system requirements.)
C. Purge middle hose of air and pressurize system to cylinder pressure.
D. Start compressor motor and add vapor refrigerant slowly into the system.
E. Charge by effect. As more refrigerant is added more of the evaporator should become cold. Stop charging when one half to two thirds of the evaporator is cooling.

II. Students charge a refrigeration system.

METAL

CONTENT TITLE: Assembling a Refrigeration System

SUB OBJECTIVE 29: The student will demonstrate ability to perform an operational check.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the refrigeration cycle and pressure-temperature charts.

II. Instructor demonstrates performing an operational check.

A. Record suction and discharge pressures.
B. Measure amperage draw of compressor motor.
C. Stop compressor and record time necessary for high and low pressure lines to equalize.
D. Find evaporating and condensing temperature from pressure and temperature chart using the known pressure.

III. Students perform an operational check.

METAL

OVERALL OBJECTIVE: The student will observe the effects over and under charging and changing settings on the AEV and TEV settings obtained on an operating refrigeration system.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and A. F. Bracciano, Modern Refrigeration and Air Conditioning, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1968.

Trane Air Conditioning Manual, (Trane Company Educational Division: 3600 Pammel Creek Road, La Crosse, Wisconsin 54601).

Trane Reciprocating Refrigeration Manual, (Trane Company Educational Division, 3600 Pammel Creek Road, La Crosse, Wisconsin 54601).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Pressure measurements

Science

- Super heat
- Thermostatic expansion valves
- Capillary tubes
- Automatic expansion valves

Communication Skills

- Manufacturer's literature
- Vocabulary development
- Student Resource Manual

METAL

CONTENT TITLE: Metering Devices

SUB OBJECTIVE 30: The student will observe the effects of over and under charging on an operating refrigeration system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses capillary tubes.

A. Discuss operation of capillary tube.
B. Discuss operation of capillary tube system.
C. Assign student an operating capillary tube system without a refrigerant charge.

II. Instructor demonstrates effects of over, under and proper charging of refrigeration systems.

A. Demonstrate connecting a gauge and manifold and evacuate system.
B. Demonstrate system.

III. Students observe the effect of over and under charging a system.

METAL

CONTENT TITLE: Metering Devices

SUB OBJECTIVE 31: The student will observe the effects and changes in the AEV setting obtained on an operating refrigeration system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses AEV valves.

A. Discuss operation of automatic expansion valve.
B. Compare to other constant pressure regulators within the trade.
C. Discuss application.
D. Assign operating machine to student.

II. Student observes the operation of AEV's.

CONTENT TITLE: Metering Devices

SUB OBJECTIVE 32: The student will observe the effects and changes in the TEV setting obtained on an operating refrigeration system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses TEV's.

A. Discuss operation of thermostatic expansion valve, (TEV).
B. Discuss super heat.
C. Demonstrate operation of thermostatic expansion valve.
D. Assign student an operating machine with TEV and system fully charged.

II. Students observe operation of TEV's.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to install a prefabricated walk-in refrigeration system.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and A. F. Bracciano, Modern Refrigeration and Air Conditioning, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1968.

Trane Air Conditioning Manual, (Trane Company Education Division: 3600 Pammel Creek Road, La Crosse, Wisconsin 54601).

Trane Reciprocating Refrigeration Manual, (Trane Company Education Division: 3600 Pammel Creek Road, La Crosse, Wisconsin 54601).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Temperature measurement

Science

- Insulation theory

Communication Skills

- Interpretation of schematics
- Manufacturer's literature

METAL

CONTENT TITLE: Prefabricated Walk-in Refrigeration Systems

SUB OBJECTIVE 33: The student will demonstrate ability to assemble a prefabricated walk-in refrigerator.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates assembling a prefabricated walk-in refrigerator.

A. Discuss unloading and laying out of panels.
B. Identify numbering and labeling method of panels for assembling.
C. Discuss vapor sealing joints.
D. Discuss securing joints.
E. Discuss hinges, latches and strikes.
F. Supervise very closely handling and assembling of refrigerator panels.
G. Demonstrate layout and assembly of floor, wall and ceiling panels.

II. Students assemble a prefabricated walk-in refrigerator.

METAL

CONTENT TITLE: Prefabricated Walk-in Refrigeration Systems

SUB OBJECTIVE 34: The student will demonstrate ability to install the refrigeration system for a prefabricated walk-in.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses aspects of installing refrigeration systems.

A. Discuss mounting air handling unit.
B. Discuss installing and sealing pipe insulation.
C. Describe purpose and forming of vibration loops.
D. Describe hi-low pressure safety switches.
E. Describe thermostat control.
F. Discuss purpose of a liquid indicator or sight glass.
G. Demonstrate estimating pipe and fitting for evaporator drain, liquid line and suction line.
H. Demonstrate installation of liquid line, suction lines and drain pipes.

II. Students install a refrigeration system.

METAL

CONTENT TITLE: Prefabricated Walk-In Refrigeration Systems

SUB OBJECTIVE 35: The student will demonstrate ability to evacuate-charge the refrigeration system for a prefabricated walk-in.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses evacuating and charging a refrigeration system.

   A. Discuss driers and sight glasses or liquid indicators.
   B. Supervise evacuation and charging.

II. Students evacuate and charge a refrigeration system.

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METAL

OVERALL OBJECTIVE: Given a water-cooled, packaged air conditioning unit in which the heavy equipment has been positioned and installed, the student will demonstrate ability to connect the water and electrical service to the cooling tower, to start and perform operation checks on the fans and other water tower equipment and to perform final operation checks on the complete system using psychometric measuring instruments.

SOURCES OF INFORMATION

Althouse, A. D., C. H. Turnquist and A. F. Bracciano, Modern Refrigeration and Air Conditioning, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1968.

Trane Air Conditioning Manual, (Trane Company Education Division: 3600 Pammel Creek Road, La Crosse, Wisconsin 54601).

Trane Reciprocating Refrigeration Manual, (Trane Company Education Division: 3600 Pammel Creek Road, La Crosse, Wisconsin 54601).

Continued...

METAL

OVERALL OBJECTIVE: Given a water-cooled, packaged air conditioning unit in which the heavy equipment has been positioned and installed, the student will demonstrate ability to connect the water and electrical service to the cooling tower, to start and perform operation checks on the fans and other water tower equipment and to perform final operation checks on the complete system using psychometric measuring instruments.

(Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Level and plumb
- Degrees and angles
- Using catalog numbers and pricing

Science

- Lubrication theory
- Water treatment chemicals
- Relative humidity
  - Dry bulb
  - Wet bulb

Communication Skills

- Blueprint reading
- Manufacturer's literature
- Discuss career possibilities and alternatives in air conditioning and heating
- Review Junior and Senior College Catalogs
- Trade association information -- MCA and APHCC
- Apprenticeship expectations and information

METAL

CONTENT TITLE: Water-Cooled Packaged Air Conditioners

SUB OBJECTIVE 36: The student will demonstrate ability to connect the water pipes for a water-cooled, packaged air conditioner.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installing water pipes.

A. Discuss cooling tower operation.
B. Discuss water pump operation.
C. Discuss water cooled condenser operation.
D. Discuss layout of water pipes.

II. Instructor demonstrates connecting a water tower.

A. List pipe and fittings.
B. Cut holes for water pipes through walls and partitions for water pipes.
C. Connect water cooled condenser to cooling tower and water pump.
D. Connect water pump to cooling tower.
E. Connect make up water supply to float valve.
F. Plug drain.
G. Fill cooling tower with water.
H. Adjust water level.

III. Students connect a water tower to a refrigeration unit.

METAL

CONTENT TITLE: Water-Cooled Packaged Air Conditioners

SUB OBJECTIVE 37: The student will demonstrate ability to connect the electrical service for a water-cooled, packaged air conditioner.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installing electrical service.

   A. Diagram circuits.
   B. Discuss operation of circuits.
   C. Discuss overall operation of system.

II. Instructor demonstrates connecting electrical service.

   A. Mount fused disconnect.
   B. Mount starter.
   C. Install wire connecting pump, tower fan, air conditioning unit, starters and switches.

III. Students connect electrical service.

METAL

CONTENT TITLE: Water-Cooled Packaged Air Conditioners

SUG OBJECTIVE 38: The student will demonstrate ability to start a water-cooled, packaged air conditioning unit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses starting an air conditioning unit.

A. Discuss start up procedures.
B. Discuss safety switches.
C. Demonstrate sounds of motors and pumps at start up and under normal operating conditions.

II. Instructor demonstrates start up procedure.

A. Lubricate motor bearings. (Some motors are lubricated at factory.)
B. Operate complete system.
C. Make quick, rough checks by sight, sound and touch of compressor motor, evaporator fan motor, water pump motor, cooling tower fan motor and water distribution within the tower.
D. Stop system if there are any obvious malfunctions in tower-pump unit, compressor unit or evaporator-fan unit.

III. Students perform start up tests.

CONTENT TITLE: Water-Cooled Packaged Air Conditioners

SUB OBJECTIVE 39: The student will demonstrate ability to perform an operation check on the evaporation fan section.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates performing operation checks.

A. Check fan-off-cool switch.
Check motor pulley adjustment.
Check belt tension adjustment.
Check motor pulley adjustment.

B. Demonstrate use of psychometers and adjusting thermal expansion valve.

II. Student performs operation checks.

CONTENT TITLE: Water-Cooled Packaged Air Conditioners

SUB OBJECTIVE 40: The student will demonstrate ability to perform an operation check on the compressor motor section.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates checking the compressor motor section.

A. Check compressor air passage.
B. Demonstrate adjusting pressure switch.
C. Demonstrate making pressure measurements.
D. Demonstrate making temperature checks.

II. Student checks the compressor motor section.

METAL

CONTENT TITLE: Water-Cooled Packaged Air Conditioners

SUB OBJECTIVE 41: The student will demonstrate ability to perform an operation check on the tower-pump section.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses operation of cooling tower, pump priming, scale problems, water levels, vortexes, etc.

II. Instructor demonstrates performing an operational check on the tower-pump section.

A. Check pump operation (correct rotational direction, current draw, etc.).
B. Check fan operation.
C. Check water flow and plumbing (correct vortex if necessary).
D. Check water condition and conditioners.

III. Students perform operational check.

CONTENT TITLE: Water-Cooled Packaged Air Conditioners

SUB OBJECTIVE 42: The student will demonstrate ability to perform an operation check by psychometrics.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor introduces psychometric aspects of refrigeration evaluation.

A. Demonstrate psychometer and use of psychometric charts.
B. Outline operational areas to be tested.

II. Students perform psychometric evaluations of a refrigeration system.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to safely and effectively move heavy materials laterally with pipe rollers and vertically by the cribbing method.

SOURCES OF INFORMATION

Rossnagle, W. E., Handbook of Rigging, (McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020), 1964.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Addition
- Subtraction
- Multiplication
- Division
- Whole numbers
- Fractions
- Decimals

Science

- Simple machines
- Hydraulic jacks
- Center of gravity
- Inertia
- Friction

Communication Skills

- Manufacturer's literature
- Blueprint interpretation
- Engineering specs
- Student Resource Manual
- Related safety

METAL

CONTENT TITLE: Move Heavy Equipment

SUB OBJECTIVE 43: The student will demonstrate ability to raise safely a heavy load to a concrete mounting pad using the cribbing method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the cribbing method of raising a heavy load.

A. Discuss safety considerations.
B. Raise end of skid mounted pad and place 2 x 4's cross-ways under end, using a hydraulic jack.
C. Raise opposite end and repeat process.
D. Raise one side of pad placing 2 x 4's under skid longitudinally.
E. Repeat process on opposite side.
F. Continue raising and placing criss-crossed cribbing until load reaches the desired height, (last crib timbers should be parallel with skids).
G. Position rollers and move load onto concrete pad.
H. Center anchor holes over anchor bolts (set in concrete) and lower load.

II. Student uses cribbing method to raise a heavy load.

METAL

CONTENT TITLE: Move Heavy Equipment

SUB OBJECTIVE 44: The student will demonstrate ability to safely move a skid mounted load, laterally, using pipe rollers and coffin hoists.

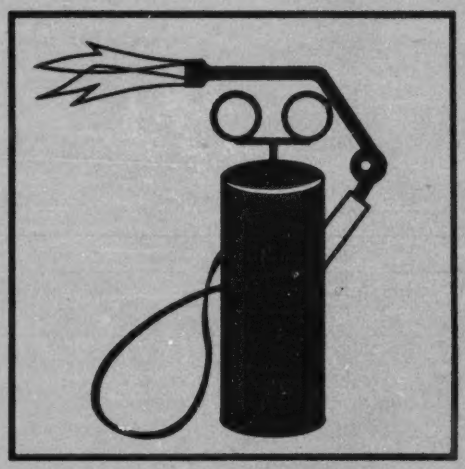
SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates load moving with pipe rollers and a coffin hoist.

   A. Raise front end of load using ship mule or crowbar and block fulcrum.
   B. Insert pipe roller.
   C. Raise opposite end, inserting second roller under skids slightly to the rear of center.
   D. Place third roller in front of load and on floor, 18' from first roller (catch-up roller).
   E. Attach coffin hoist and operate hoist to move load.
   F. Feed new rollers under load at intervals as necessary.

II. Student moves a heavy load using pipe rollers and a coffin hoist.

MILLWRIGHTING AND INDUSTRIAL MECHANICS



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METAL

OVERALL OBJECTIVE: The student will demonstrate ability to measure, lay out, cut, thread, fasten, drill, etc., metals using common tools and procedures common to millwrighting.

SOURCES OF INFORMATION

"Files, Wall Charts," (Nicholson File Company: 667 Waterman Avenue, East Providence, Rhode Island 02914).

Krar, et. al., Technology of Machine Tools, (McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020), 1969.

Department of the Navy, Machinery Repairman 3 & 2, NAVPERS 10530-D. (Order from GPO, Document #D208.11:M18/3/970).

Oberg, Erik and Franklin D. Jones, Machinery's Handbook, 19th Edition, (Industrial Press: 200 Madison Avenue, New York, New York 10016), 1971.

Precision Measures, (L. S. Starrett Co.: 1-165 Crescent Street, Athol, Massachusetts 01331).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Interpolation of micrometers and gauges
- Square and plumb
- Material and tool sizing

Communication Skills

- Related safety
  - Electrical tool operation -- drilling, threading, reaming, sharpening
  - V belts
- Manufacturer's literature
- Student Resource Manual
- Blueprint interpretation

METAL

CONTENT TITLE: Precision Measurement

SUB OBJECTIVE 1: The student will demonstrate ability to use various measuring devices to make accurate measurements.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor lectures on and demonstrates the uses of the following tools:

A. Taper plug gauges.
B. Thread ring gauges.
C. Squares, both adjustable and precision.
D. Surface plates.
E. Micrometers, including calipers, inside, depth and pitch micrometers.
F. Vernier instruments such as calipers, protractors (bevel) and height gauges.
G. Small hole gauges.
H. Telescoping gauges.
I. Gauges blocks.
J. Sine bar.
K. Dial indicators.
L. Optical flats.
M. Surface indicator.
N. Precision level.

II. Students operate various measuring tools by applying them to secure the various measurements assigned by the instructor.

METAL

CONTENT TITLE: Layout Tools

SUB OBJECTIVE 2: The student will demonstrate ability to use appropriate tools to make a precision layout.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses tools used in layout and demonstrates preparing a precision layout.

   A. Discuss use of tools such as scribers and layout solutions, combination square sets, beam tramnels, angle plates, keyseat clamps, dividers and surface gauges.
   B. Prepare surface for layout operation.

II. Have the students perform layout operations as per operation sheet.

METAL

CONTENT TITLE: Hand Tools and Bench Work

SUB OBJECTIVE 3: The student will demonstrate ability to perform basic shop and field operations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates using special tools for basic shop and field operations.

A. Torquing bolts.
B. Cutting barstock.
C. Threading barstock.
D. Broaching a keyway.
E. Drawfiling keystock.
F. Lapping keystock.
G. Tapping plate.
H. Reaming holes.
I. Include demonstrations of at least the following tools: Box end and open end wrenches, socket wrenches, torque wrenches, hammers, chisels, strap and chain wrenches, spanner wrenches, vises, hacksaws, files, taps and tap extractors, threading dies, reamers, broaches and lapping plates.

II. Students practice using tools by executing the basic shop and field operations.

METAL

CONTENT TITLE: Drilling Machines and Operations

SUB OBJECTIVE 4: The student will demonstrate ability to operate correctly a drill press and to select and resharpen twist drills for specific jobs.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates drilling machines and accessories.

A. Discuss sizes of drill presses.
B. Illustrate components of the drill press.
C. Demonstrate operations performed on the drill press.
D. Illustrate work holding devices.
E. Discuss twist drills; illustrate their parts, sizing, types and sharpening.
F. Discuss drilling speeds and feeds.
G. Discuss drill failures.
H. Discuss machine reamers.
I. Illustrate use of center drills.
J. Illustrate use of accurate drill location (center finder).
K. Demonstrate tapping in drill press.
L. Discuss drill press safety.
M. Discuss magnetic drill press.
N. Demonstrate use of the "Old Man" for field drilling.
O. Demonstrate use of hand drills.

II. Students demonstrate understanding of drilling machines and components by doing the operations with instructor supervision. STRESS SAFETY.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to select and/or prepare bits, feed speed, turn speed, etc., to perform straight turning, between center turning, taper cutting and inside boring operations.

SOURCES OF INFORMATION

How to Run a Lathe, (L. S. Starrett Co.: 1-165 Crescent Street, Athol, Massachusetts 01331).

Krar, et. al., Technology of Machines, (McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020), 1969.

Department of the Navy, Machinery Repairman 3 & 2, NAVPERS 10530-D. (Order from GPO, Document No. D208.11:M18/3/970).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Machine and material sizing
- Locate centers
- Diameters - inside and outside

Science

- Cutting and machining of metal

Communication Skills

- Manufacturer's literature
- Related safety - machine usage

METAL

CONTENT TITLE: Engine Lathe

SUB OBJECTIVE 5: The student will demonstrate ability to identify basic components of a lathe and to select feed speeds for various materials.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates the engine lathe and explains how this machine tool is used in the overhaul and maintenance of industrial equipment.

   A. Discuss lathe sizes and capacity.
   B. Discuss basic components of the lathe.
   C. Discuss setting speeds and feeds.
   D. Illustrate lathe accessories; demonstrate using centers, chucks, faceplates, steady and follower rests.
   E. Define cutting speeds for different materials.
   F. Define depth of cuts for different materials.
   G. Illustrate lathe toolholders for different jobs.

II. Students practice using lathe.

METAL

CONTENT TITLE: Engine Lathe

SUB OBJECTIVE 6: The student will demonstrate ability to select and grind, appropriately, tool bits to perform a straight turning operation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates tool bits used on the lathe and grinding techniques used in sharpening them.

A. Discuss cutting tool materials.
B. Outline advantages of each.
C. Discuss cemented carbides.
D. Discuss cutting tool nomenclature.
E. Demonstrate setting tool bit angles. Allow for side angle, end angle, side relief, end relief, side rake and back rake.
F. Demonstrate the tools used to measure these angles and reliefs.
G. Demonstrate the procedures used to grind these angles and reliefs.
H. Demonstrate mounting work into a three jaw universal chuck.
I. Demonstrate setting the tool bit into the tool holder for correct height and angle.
J. Demonstrate grinding tools for rough turning, finish turning, turning to a shoulder, grooving and necking.

II. Students practice selecting, setting, using and grinding tool bits.

METAL

CONTENT TITLE: Engine Lathe

SUB OBJECTIVE 7: The student will demonstrate ability to work between centers.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates turning work between centers.

   A. Install face plate on lathe.
   B. Install dead center in headstock.
   C. Prepare workpiece by drilling centers.
   D. Grind tool bit for required job.
   E. Select dog for workpiece.
   F. Install dog on workpiece.
   G. Insert workpiece in lathe.
   H. Adjust tailstock for proper tension.
   I. Adjust tool bit for height and angle.
   J. Make desired cut.

II. Students practice turning work between centers.

METAL

CONTENT TITLE: Engine Lathe

SUB OBJECTIVE 8: The student will demonstrate ability to cut tapers using a lathe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor should discuss and demonstrate cutting tapers on the lathe.

   A. Discuss types of tapers.
   B. Demonstrate making taper calculations.
   C. Demonstrate methods of taper turning on the lathe.
   D. Discuss tailstock offset.
   E. Illustrate taper attachments.
   F. Discuss compound rest setting for tapers.
   G. Demonstrate methods of measuring tapers.
   H. Grinding tool bits for tapers.

II. Students set up a lathe for turning a taper.

METAL

CONTENT TITLE: Engine Lathe

SUB OBJECTIVE 9: The student will demonstrate ability to center work in a four-jaw chuck and bore an inside diameter.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses centering work into a four-jaw chuck and the process for boring an inside diameter.

   A. Remove three-jaw chuck.
   B. Install four-jaw chuck.
   C. Set chuck jaws approximately equidistant.
   D. Install work in the jaws.
   E. Using tail of the tool holder, roughly align work to within 1/64 of an inch.
   F. Set up dial indicator on a magnetic base.
   G. Center work to within 0.001" using dial indicator.
   H. Set up boring bar on compound.
   I. Grind tool bit necessary for particular boring job.
   J. Bore inside diameter to desired dimension.
   K. Check for accuracy.

II. Students center work in a four-jaw chuck and bore an inside diameter.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to identify bearings by type, designation, dimensions and typical application and to install anti-friction bearings using the heat and press fitting methods.

SOURCES OF INFORMATION

Anti-Friction Bearing Maintenance, AFBMA-100, (Fafnir Bearing Co.: Booth Street, New Britain, Connecticut 06050).

Bearing Designation, (Anti-Friction Bearing Manufacturer's Association: 60 East 42nd Street, New York, New York 10017).

Cunningham Bearing Manual, (Cunningham Bearing Co.: 6618 East Highway 332, Houston, Texas).

Fafnir Numbering System, (Fafnir Bearing Co.: Booth Street, New Britain, Connecticut 06050).

Krar, et. al., Technology of Machine Tools, (McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020), 1969.

Mounting Data, (Fafnir Bearing Co.: Booth Street, New Britain, Connecticut 06050).

Oberg, Erik and Franklin D. Jones, Machinery's Handbook, 19th Edition, (Industrial Press: 200 Madison Avenue, New York, New York 10016), 1971.

Continued...

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to identify bearings by type, designation, dimensions and typical application and to install anti-friction bearings using the heat and press fitting methods.

(Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Numbering system for bearings
- Catalog and index numbers
- Tolerances

Science

- Anti-friction devices
  - Wear and usage
  - Freeze up
  - Lubrication

Communication Skills

- Manufacturer's literature
- Material manuals
- Student Resource Manual
- Related safety - over usage

METAL

CONTENT TITLE: Anti-Friction Bearings

SUB OBJECTIVE 10: The student will demonstrate ability to determine type, designation, dimensions and typical applications of basic bearings.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses anti-friction bearings.

A. Identify bearing types according to loads and the various types of loads imposed upon bearings.
B. Identify the basic components of all anti-friction ball bearings.
C. Discuss how each type of bearing accommodates each of the loads imposed upon it.
D. Demonstrate various types of bearings to students.
E. Illustrate applications of each type of bearing.

II. Instructor discusses anti-friction bearing designations.

A. Explain the numbering system of the Anti-Friction Bearing Manufacturer's Association.
B. Explain the new numbering system that is becoming standard.
C. Explain the dimension series used to describe the dimensions of bearings.
D. Demonstrate how bearing manual is used.
E. Explain the dimensions necessary for proper installation of bearings on shafts and in housings.
F. Demonstrate why one bearing on all centrifugal pumps must be secured and one must be allowed to float.
G. Explain the purpose of having one "interference fit" and one "push fit" on anti-friction bearings.

III. Students practice identifying and classifying bearings.

METAL

CONTENT TITLE: Anti-Friction Bearings, Expansion Fit

SUB OBJECTIVE 11: The student will demonstrate ability to install anti-friction bearings using heat expansion techniques.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing an anti-friction bearing on a shaft.

A. Remove any foreign matter from bearing seat on shaft.
B. Measure (with micrometer) bearing seat on shaft in two directions and record on paper.
C. Check bearing seat for burrs.
D. Check shaft shoulder for burrs.
E. Measure (with micrometer) bearing bore in two directions and record.
F. Check with the Mounting Data booklet to ensure correct amount of interference between shaft and bearing.
G. Put bearing into oven, or oil sweat pot, at temperature of no more than 250 degrees Fahrenheit.

NOTE: Stress safety precautions that should be exercised when dealing with temperatures of this nature and also the safety measures to be observed when heating oil.

H. Coat bearing seat with a suitable anti-sieze compound to prevent gauling when removing bearing.
I. Secure a shaft sleeve and have at hand to use in taping bearing on if necessary.

J. Put on asbestos gloves prior to removing bearing from the oven or the oil bath.

NOTE: If oil bath is used, suspend the bearing from the bottom of the pot with a wire or hook.

Continued...

CONTENT TITLE: Anti-Friction Bearings, Expansion Fit

(Continued)

SUB OBJECTIVE 11: The student will demonstrate ability to install anti-friction bearings using heat expansion techniques.

SUGGESTED ACTIVITIES: (Students and Teachers)

K. Remove the bearing from the oven and position on shaft.

CAUTION: Make sure that bearing is completely flush against shaft shoulder when it is installed; do not wait even a minute as bearing siezes shaft almost instantly.

L. Explain that in some cases the shaft may have to be shrunk if the bearing cannot be expanded.

II. Students practice installing bearings.

METAL

CONTENT TITLE: Anti-Friction Bearing Installation, Press Fit

SUB OBJECTIVE 12: The student will demonstrate ability to install anti-friction bearings using press-fitting techniques.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing bearings using an arbor or hydraulic press.

A. Secure shaft and bearing to be installed.
B. Clean shaft and check for burrs.
C. Check shoulder for burrs and foreign matter.
D. Measure (using micrometer) shaft in two directions and record.
E. Measure bearing bore in two directions and record.
F. Check with Mounting Data booklet to ensure the proper amount of interference fit.
G. Adjust hydraulic press table for proper height.
H. Position pressing pads under ram.
I. Position bearing so that pads rest directly under the inner ring of the bearing.
J. Ensure that the outer ring turns freely.

NOTE: Make provisions for something or someone to secure shaft during pressing operation.

K. Start pressing shaft through bearing.

NOTE: Release the pressure periodically to ensure that shaft is not twisted or cocked on the bearing.

L. Observe pressure gauge on press to ensure that excessive pressure is not applied when bearing reaches shaft shoulder.

Continued...

CONTENT TITLE: Anti-Friction Bearing Installation, Press Fit (Continued)

SUB OBJECTIVE 12: The student will demonstrate ability to install anti-friction bearings using press-fitting techniques.

SUGGESTED ACTIVITIES: (Students and Teachers)

M. Release pressure from press ram and stow press accessories in proper positions.

N. Note that pressing a bearing using the arbor press is accomplished in the same manner but usage is generally restricted to smaller bearings where less pressure is required.

II. Students practice installing bearings by press-fitting them.

METAL

OVERALL OBJECTIVE: The student will identify the basic components, types, applications, operating parameters and problem symptoms of centrifugal pumps with a degree of competence to be determined by the instructor. In addition, the student will demonstrate ability to prepare a foundation for and install a centrifugal pump base.

SOURCES OF INFORMATION

Centrifugal Pump Fundamentals, (Ingersol-Rand: 11 Broadway, New York, New York 10004).

Hicks, Tyler G., Pump Selection and Application, (McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020), 1957.

Karrassik, Igor J., Centrifugal Pumps, (McGraw-Hill: 1221 Avenue of the Americas, New York, New York 10020), 1960.

Department of the Navy, Machinery Repairman 3 & 2, NAVPERS 10530-D. (Order from GPO, Document No. D208.11:M18/3/970).

Oberg, Erik and Franklin D. Jones, Machinery's Handbook, 19th Edition, (Industrial Press: 200 Madison Avenue, New York, New York 10016), 1971.

Pump Engineering Manual, (Duriron Co., Inc.: 425 North Findlay Street, Dayton, Ohio 45404).

Pump Fundamentals, (Goulds Pumps, Inc.: 240 Fall Street, Seneca Falls, New York 13148).

Continued...

METAL

OVERALL OBJECTIVE: The student will identify the basic components, types, applications, operating parameters and problem symptoms of centrifugal pumps with a degree of competence to be determined by the instructor. In addition, the student will demonstrate ability to prepare a foundation for and install a centrifugal pump base.

(Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- R.P.M., G.P.M., P.S.I. (measurements)

Science

- Pump theory
- Charging and priming pumps
- Horsepower
- Hydraulics
- Motors and turbines

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Vocabulary development
- Catalog and parts identification

METAL

CONTENT TITLE: Centrifugal Pumps

SUB OBJECTIVE 13: The student will demonstrate understanding of the basic parts of a centrifugal pump.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and illustrates centrifugal pumps and their components.

A. Define pumping.
B. Define centrifugal pumps.
C. Identify basic parts of any centrifugal pump.
D. Outline means by which a centrifugal pump is classified.
E. Discuss volute type casing of a centrifugal pump.
F. Discuss diffuser type casing of a centrifugal pump.
G. Discuss circular type casing of a centrifugal pump.
H. Define turbine pumps.
I. Note difference between a single-stage and multi-stage pump.
J. Illustrate the difference between various types of impellers.
K. Define radial thrust and pre-rotation.
L. Explain functions of wearing rings.
M. Explain the difference between static and dynamic balance.
N. Demonstrate a critical speed using a pedestal grinder.
O. Illustrate the function of a shaft sleeve.
P. Explain the purpose of a stuffing box.
Q. Illustrate some of the bearings used in centrifugal pumps.
R. Illustrate some of the different types of couplings used on centrifugal pumps.
S. Illustrate the difference between soleplates and bedplates in pumps.

II. Students examine and discuss various types of centrifugal pumps as given them by the instructor.

METAL

CONTENT TITLE: Centrifugal Pumps

SUB OBJECTIVE 14: The student will demonstrate ability to identify types of centrifugal pumps and their uses.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor illustrates and discusses the various types of pumps and their applications in industry.

   A. Define a booster pump.
   B. Define a circulating pump.
   C. Discuss purpose of a charge pump.
   D. Discuss purpose of a non-clogging pump.
   E. Define the following pumps: Dry-pit, sludge, wet-pit pump, sump pump, vertical turbine, vertical propeller, closed-coupled, in-line pump and can pump.
   F. Designate the rotation of the pump.
   G. Discuss meaning of outboard and inboard.

II. Students examine and discuss various types of pumps as given them by the instructor.

METAL

CONTENT TITLE: Centrifugal Pumps

SUB OBJECTIVE 15: The student will demonstrate ability to define and determine correct operating parameters for basic centrifugal pumps.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates principles and discusses operating parameters of basic centrifugal pumps.

   A. Identify terms used to describe the capacity and pressure of a pump.
   B. Explain the relationship between head pressure and PSI.
   C. Define liquid horsepower and brake horsepower.
   D. Discuss the efficiency of a centrifugal pump.
   E. Explain the following terms in pumping: Vapor pressure, NPSH, cavitation, head capacity curve, viscosity, affinity laws of hydraulics and determining the head for a given impeller.
   F. Demonstrate effect of throttling the suction side of pump.
   G. Demonstrate effect of throttling the discharge side of pump.
   H. Explain advantages of having different types of drivers.
   I. Demonstrate proper steps of throttling.

II. Students practice determining operating parameters.

METAL

CONTENT TITLE: Centrifugal Pumps

SUB OBJECTIVE 16: The student will observe correct and incorrect pump operation and will demonstrate ability to ascertain areas of malfunction on the basis of his observations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses areas that affect pump performance.

A. Discuss effect of suction pipe size changes.
B. Discuss design criteria for suction pipe to allow for proper entrance of liquid to impeller.
C. Discuss location of vents in pump piping system.
D. Discuss purpose of installing a check valve in the discharge line.
E. Discuss preparation of pump foundation.
F. Discuss function of grouting.
G. Discuss necessity of keeping standby pumps ready for operation.
H. Discuss effects of running pumps with discharge valves closed.
I. Discuss purpose of throttling.
J. Demonstrate proper starting and stopping procedures for motor-driven pumps.
K. Demonstrate proper starting and stopping procedures for turbine driven pumps.
L. Outline necessary observations to be made when pump is operating.
M. Discuss relubrication schedule.
N. Demonstrate repacking stuffing box.
O. Demonstrate installation of impellers.
P. Discuss wear ring replacement schedule.
Q. Illustrate symptoms of running a pump in reverse.
R. Discuss pump priming.
S. Outline common pump difficulties.

II. Students observe correct and incorrect pump operation and ascertain areas of pump malfunction based on their observations.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to align shafts using the two-indicator, dynamic to static and indicator-reverse methods.

SOURCES OF INFORMATION

Factors Affecting and Principles of Shaft Alignment, (Dreyco Mechanical Services: 5411 Laurel Creek Way, Houston, Texas 77017).

Department of the Navy, Machinery Repairman 3 & 2, NAVPERS 10530-D. (Order from GPO, Document No. D208.11:M18/3/970.)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Balance and shimming

Science

- Principles of alignments

Communication Skills

- Manufacturer's literature
- Related safety - V belts, gears, chains

METAL

CONTENT TITLE: Shaft Alignment

SUB OBJECTIVE I7: The student will demonstrate ability to align shafts using the two-indicator method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the following pertaining to the principles of shaft alignment.

   A. Discuss factors affecting shaft alignment.
   B. Discuss effect of poor alignment on bearings and mechanical seals.
   C. Illustrate a proper alignment record.
   D. Demonstrate an indicator bracket sag.
   E. Explain the principles of bracket sag.
   F. Explain the purpose of taking a "hot check."
   G. Demonstrate procedures of taking a "hot check."
   H. Demonstrate calculating thermal growth.
   I. Demonstrate detecting misalignment on an operating machine using appropriate test instruments.

II. Instructor demonstrates aligning two shafts using the two-indicator method.

   A. Lock out equipment and tag.
   B. Clean feet and pads.
   C. Make provisions for coupling gap.
   D. Temporarily connect coupling.
   E. Install indicator brackets and indicators.
   F. Check for soft foot.
   G. Align close side to side.
   H. Calculate necessary shims on the strength of top to bottom readings.
   I. Make necessary shim changes.
   J. Take final reading.

III. Students perform an alignment operation using the two-indicator method.

METAL

CONTENT TITLE: Shaft Alignment, Dynamic to Static Method

SUB OBJECTIVE 18: The student will demonstrate ability to perform a dynamic-to-static shaft alignment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates aligning two shafts when only one shaft can be easily rotated.

A. Lock out and tag equipment.
B. Clean pads and feet.
C. Make provisions for coupling gap.
D. Temporarily connect coupling.
E. Install indicator brackets and indicators.
F. Check for soft foot.
G. Take readings from run-out of shaft.
H. Take readings from one shaft to other.
I. Correct for run-out and for bracket sag.
J. Calculate shims required.
K. Make shim change and lateral shift.
L. Take final reading.

II. Students perform a dynamic-to-static shaft alignment.

METAL

CONTENT TITLE: Shaft Alignment, Indicator-Reverse Method

SUB OBJECTIVE 19: The student will demonstrate ability to align shafts using the indicator-reverse method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates aligning two shafts using the indicator-reverse method.

A. Lock out and tag equipment.
B. Clean pads and feet.
C. Make provisions for coupling gap.
D. Temporarily connect coupling.
E. Install indicator brackets and indicators.
F. Check for soft foot.
G. Take driver-to-driven readings.
H. Take driven-to-driver readings.
I. Correct and collect readings.
J. Plot readings.
K. Make shim change and lateral moves.
L. Take final readings.

II. Students perform an indicator-reverse alignment procedure.

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to determine fits and tolerances of machined parts and to perform basic maintenance procedures on various types of mechanical equipment.

SOURCES OF INFORMATION

Black, Perry O., Pumps, (Theodore Audel and Co., Division of Howard W. Sams and Co.: 4300 West 62nd Street, Indianapolis, Indiana), 1969.

Dura Seal Manual, (Durametallic Corp.: 2164 Factory Street, Kalamazoo, Michigan 49001).

Fundamentals of Mechanical End Face Seals, (Crane Packing Co.: 6400 Oakton Street, Morton Grove, Illinois 60053).

Installation Instructions - John Crane Shaft Seals, (John Crane Packing Co.: 300 Park Avenue, New York, New York 10022).

Mechanical Seal Report #12, (Borg-Warner Seal Co.: 200 South Michigan Avenue, Chicago, Illinois 60604).

Department of the Navy, Machinery Repairman 3 & 2, NAVPERS 10530-D. (Order from GPO, Document No. D208.11:M18/3/970.)

Shaft Packing, (Crane Packing Co.: 6400 Oakton Street, Morton Grove, Illinois 60053).

Continued...

METAL

OVERALL OBJECTIVE: The student will demonstrate ability to determine fits and tolerances of machined parts and to perform basic maintenance procedures on various types of mechanical equipment.

(Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Equipment and parts sizing
- Gears, chains and V belt sizing

Science

- Types of seals
- Lubricants - oils and greases

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Vocabulary development
- Blueprint interpretation
- Locating parts and identification numbers

METAL

CONTENT TITLE: Mechanical Equipment

SUB OBJECTIVE 20: The student will demonstrate ability to determine fits and tolerances for shafts and bores.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses fits and tolerances.

A. Explain the basic types of fits.
B. Demonstrate establishing basic dimension.
C. Show the amount of tolerance that is given each dimension.
D. Explain the various classes of each of the types of fits.
E. Demonstrate using charts to determine basic size and tolerance.
F. Demonstrate securing assembly clearances.
G. Use interference and sliding fits for this lesson. Review determining fits and tolerances.

II. Students practice determining fits and tolerances.

METAL

CONTENT TITLE: Centrifugal Pumps

SUB OBJECTIVE 2I: The student will demonstrate ability to overhaul an overhung centrifugal pump, end-suction type.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates overhauling a centrifugal pump.

A. Clean outside and inside of casing.
B. Secure pump to work bench.
C. Remove packing gland.
D. Mark face of stuffing box to shaft.
E. Remove casing from back plate.
F. Remove impeller.
G. Remove back plate.
H. Remove mechanical seal and packing gland.
I. Remove coupling half.
J. Remove outboard bearing cap.
K. Remove shaft assembly.
L. Remove bearings from shaft.
M. Check shaft for run-out at bearing seats and seal area and diameter of shaft at bearing seats, coupling end and seal area.
N. Check impeller for wear at wear bands and vane tips.
O. Check bearings for rough spots.
P. Check mechanical seal for cracks and worn spots.
Q. Check casing and bearing housing for proper dimensions and cracks.
R. Push bearings onto shaft using arbor or hydraulic press.
S. Install shaft assembly in bearing housing; replace bearing cap.
T. Install mechanical seal; set proper crush and install packing gland.
U. Install the back plate, impeller and casing.
V. Install coupling half.

II. Students overhaul centrifugal pump.

METAL

CONTENT TITLE: Mechanical Seals

SUB OBJECTIVE 22: The student will demonstrate ability to remove and install mechanical seals.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses mechanical shaft seals.

A. Define a mechanical shaft seal.
B. Discuss reasons for using mechanical seals over expendable packing.
C. Illustrate basic construction of the mechanical seal.
D. Discuss precision tolerances required in the production of seal faces.
E. Explain how seals are kept from running dry.
F. Discuss classification, by design and arrangement of seals.
G. Point out leakage points on all types of seals.
H. Explain the difference between a balanced and unbalanced seal.
I. Point out precautions taken during installation and removal of seals.
J. Explain areas that cause the most common problems with seals.

II. Students replace a worn seal.

METAL

CONTENT TITLE: Expendable Packing

SUB[illegible]TIVE 23: The student will demonstrate ability to install expendable packing in a pump.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses expendable packing.

A. Explain some of the characteristics of expendable packing.
B. Discuss applications of expendable packing.
C. Describe the various types of sealing liquids used with packing.
D. Illustrate some of the various types of packing.
E. Explain some of the criteria for selecting the proper type packing.
F. Demonstrate the basic steps for replacing packing in a pump.
G. Discuss packing life expectancies and the factors affecting their durability.
H. Discuss packing used in reciprocating pumps.
I. Explain the difference between piston packing and plunger packing.
J. Illustrate applications of piston cup packing.
K. Discuss common areas of packing failure.

II. Students remove and replace expendable packing.

METAL

CONTENT TITLE: Rotary Pumps

SUB OBJECTIVE 24: The student will demonstrate ability to disassemble and assemble a rotary pump.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses rotary pumps.

A. Define rotary pump.
B. Discuss types of rotary pumps; discuss gear types, vane types, screw types and lobe types.
C. Outline basic components for any rotary pump.
D. Discuss types of bearings used for rotary pumps.
E. Discuss types of seals used for rotary pumps.
F. Define viscosity.
G. Define displacement and slip.
H. Explain operating characteristics of rotary pumps.
I. Demonstrate principles of operation of the rotary pump.
J. Explain troubleshooting of the rotary pumps.

II. Students assemble and disassemble a rotary pump.

METAL

CONTENT TITLE: Reciprocating Pumps

SUB OBJECTIVE 25: The student will demonstrate ability to disassemble, inspect and assemble reciprocating pumps.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the various types of reciprocating pumps.

A. Illustrate basic components of the reciprocating pump.
B. Define the difference between the direct acting and power pump.
C. Discuss simplex and duplex pumps.
D. Differentiate between piston and plunger.
E. Illustrate various valve arrangements found on reciprocating pumps.
F. Define a proportioning pump.
G. Explain advantages and disadvantages of proportioning pumps.
H. Illustrate factors determining size and stalling pressure.
I. Discuss operating characteristics of the reciprocating pump.
J. Illustrate operation of pulsation dampener.
K. Demonstrate operating reciprocating pump.

II. Students disassemble, inspect and assemble a reciprocating pump.

METAL

CONTENT TITLE: Steam Turbines

SUB OBJECTIVE 26: The student will demonstrate ability to identify the basic parts of a steam turbine and its fundamentals of operation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses steam turbines.

A. Define steam turbines.
B. Differentiate between impulse and reaction turbines.
C. Discuss classification of steam turbines.
D. Discuss multistage turbines.
E. Illustrate functions of overspeed trip and governor controls.
F. Describe other means of governing turbine speed.
G. Illustrate steam flow through a turbine.

II. Instructor points out parts of the turbine.

A. Point out steam chests, nozzles, hand valves, rotors, radial and thrust bearings.
B. Explain principles of operation of the tilting pad thrust bearing.
C. Explain functions of the carbon sealing glands.
D. Explain purpose of the sentinel valve.
E. Explain basic steps in starting and stopping of turbines.

III. Have the students with the assistance of the instructor point out the various aspects of the turbines on hand to ensure complete understanding of the areas discussed in the lesson.

METAL

CONTENT TITLE: Equipment Lubrication

SUB OBJECTIVE 27: The student will demonstrate ability to lubricate a variety of plant equipment correctly.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses lubricating plant equipment.

A. Discuss applications of grease and oil.
B. Demonstrate checking grease content.
C. Demonstrate regreasing bearing.
D. Demonstrate checking for proper temperature of greased units.
E. Discuss requirements for oiling lubrication systems.
F. Demonstrate checking oil level of a unit.
G. Demonstrate checking temperature of oil in a system.
H. Illustrate the various lubricating devices for force feed system, gravity feed system, splash system, mist system and wick feed system.

II. Students practice lubricating plant equipment.

METAL

CONTENT TITLE: Power Transmission

SUB OBJECTIVE 28: The student will demonstrate ability to outline the basic types of equipment used to transmit power and to install chains in a chain-driven system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses power transmission equipment.

A. Explain the various types of gears used in machinery such as spur gears, helical gears, bevel gears and worm gears.
B. Explain characteristics of each type.
C. Discuss measurement of various gears and terminology.
D. Demonstrate procedures for measuring backlash.
E. Demonstrate methods of determining proper tooth contact.
F. Demonstrate determining horsepower for various gears.
G. Explain sizing various types of belts.
H. Discuss operating characteristics of belts and gears.
I. Discuss belt terminology.
J. Demonstrate determining belt length and center distance.
K. Demonstrate the use of silent chains and sizing.
L. Demonstrate the use of roller chains and sizing.
M. Discuss applications and maintenance of various chains.
N. Discuss chain terminology.

II. Students work with power transmission equipment.

METAL

CONTENT TITLE: Centrifugal Pump Installation

SUB OBJECTIVE 29: The student will demonstrate ability to install a centrifugal pump base.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates pump installation and foundation preparation.

A. Demontrate preparing foundation to receive pump base.
B. Check the foundation bolts to ensure sufficient clearance around bolt and sleeve.
C. Check the foundation bolts to ensure correct center-to-center dimensions.
D. Secure necessary shims to make shim packs.
E. Clean bottom of base.
F. Ensure that grout hole is of sufficient size.
G. Cut week holes into corners of pump base with torch or drill.
H. Provide for lifting base with a crane.
I. Secure proper slings and shackles to base of pump, checking for kinks.
J. Oversee lifting pump into position.
K. Lower base onto foundation. (Check shim packs to ensure that they are not moved.)
L. Secure base with information bolt units.
M. Place level on discharge flange and motor pads to determine low corner.
N. Check blueprints to determine proper pump elevation and centerline requirements.
O. Clean an area of the base to serve as the longitudinal plane for leveling.
P. Level base using shim stock or set-up wedges.
Q. Secure base with nuts in preparation for grouting.
R. Grout base only after a preliminary alignment check has been accomplished.

II. Students install a centrifugal pump base.

APPENDIX

METAL

LESSON PLAN SAMPLE

OVERALL OBJECTIVE:	The student will demonstrate ability to weld butt, lap and T-joints in the flat, vertical up and overhead positions, and to braze weld mild steel and cast iron using oxyacetylene welding equipment.
SUB OBJECTIVE:	To weld a butt joint in the flat position with an oxyacetylene welder.
TOOLS AND MATERIALS:	Oxyacetylene welding rig, metal welding table, metal filler rods, welding gloves and steel plates.
I. Preparation	Chalkboard diagram, hand out work sheets showing butt welds and ways to avoid undercuts. Assigned readings are Althouse, pp. 1-26 and Hobart, p. 8.
II. Presentation	Demonstrate welding a butt joint stressing safety.
III. Application	Students weld butt joint.
IV. Tests	Performance tests.

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METAL

INTRODUCTION

Training in metal is broad enough to permit a number of job possibilities. The skills and knowledge learned can be applied to other areas within the construction industry and even other industries. Whatever jobs eventually held in construction, in the trades, technical, professional, management or distribution areas, education, experiences and preparation in metal classes are needed.

While still in school, look around to see what is offered and how it can advance your future career in construction. Math classes will give training in computations, whole numbers, fractions and decimals. Measurement is a definite requirement and the ability to measure with accuracy is a skill demanded by a technical society.

English or communication skill classes strengthen abilities to write, talk, draw, read and listen. These, too, are valuable tools to get and hold the kind of job wanted.

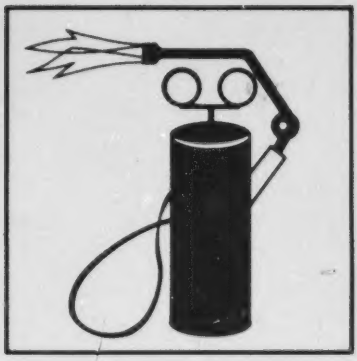
Science classes further increase understanding of the world around us. This understanding is important to anyone in construction. Whether it be electro-magnetic force; certain insulation qualities of materials; hydraulics or ecology — science classes will help deepen an awareness and understanding of the work done and the materials used.

Social science courses give a broad understanding of our political, social and economic systems. To appreciate the past increases awareness of the changes which affect our lives today.

Other areas which can help are student clubs and associations. VICA, DECA, FFA, FHA, OEA and FBLA are clubs that help many to develop leadership skills and pride of workmanship.

All of the areas described above are probably available at your high school. There are many others that can help those who have made a basic career decision. It is hoped that you are one of those students who will be able to choose your future career area.

Good luck in construction.



WELDING

INTRODUCTION

Welding is a process of joining pieces of metal by heating them until they melt and fuse together. A closely related process is soldering and brazing. This differs from welding in that, instead of melting the two primary metals, a third metal is melted between them. When the filler metal (or solder) is melted at a temperature higher than 800°F, the process is technically called soldering. Brazing also requires a temperature above 800°F. Let's consider the operations used in soldering and brazing, and then look at four types of welding: Gas welding (oxyacetylene welding), arc welding, MIG (metal-inert gas) welding and TIG (tungsten-inert gas) welding.

SOLDERING AND BRAZING

There are three types of soldering and brazing: Soft soldering, silver brazing (incorrectly termed "hard soldering") and brazing. This may seem confusing, but the differences are fairly simple. Generally speaking, *soft soldering* uses a lead-tin alloy for the filler metal. *Hard soldering* uses a silver alloy filler. *Brazing* uses a copper alloy (brass) filler.

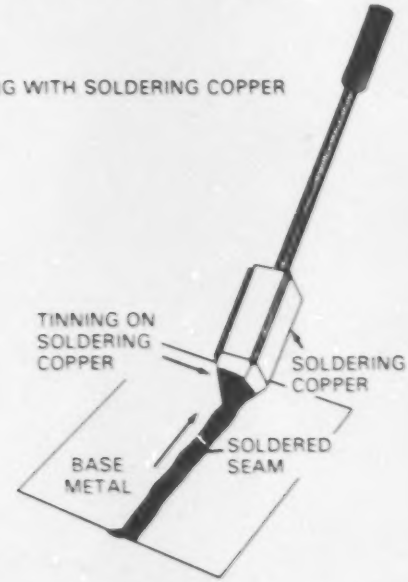
No matter what type of soldering and brazing is being done, the metals being joined must be cleaned before heat is applied to the solder. When exposed to the air, the surface of a metal chemically begins to decay by combining with oxygen. If the solder is melted over this thin film of oxidation, the joint will be weaker than if the solder joins directly to the metal. Therefore, a substance called *flux*, which cleans away the oxidation and prevents further decay, is applied to the primary metals. The kind of flux used will vary with the metals being joined, just as the kind of solder used varies with the kinds of metals which are joined. Generally, though, the most common type of flux is a mixture of zinc chloride and ammonium chloride. This is a corrosive flux; that is, it contains acid, and thus must be cleaned from the joint after the soldering operation is completed. If this is not done, the acid in the flux will decay the metal. If the operation requires a non-corrosive flux, as would be necessary for an electrical connection, a resin-based flux is used. This, too, is slightly acidic. As a rule, then, after every soldering operation, the flux should be cleaned from the joint.

SOFT SOLDERING

For soft soldering, the material used is a lead-tin alloy. Lead-tin solder comes in solid wire, bar form or resin-core wire. Resin-core wire is particularly convenient because it has flux in it. In any type of soldering or brazing, the process used does not involve actually

melting the solder. Instead, the primary metals are heated until they cause the solder material to melt and flow between them. When dealing with lead-tin alloy, a method of heating the primary metals is the *soldering copper method*. A soldering copper is a copper bar that is heated by a power source. It is four sided and is filed to a point. Once the soldering copper is clean, the solder is applied to the instrument, referred to as a soldering iron, and then the instrument itself is applied to the metals. The soldering copper heats up, transferring its heat to the metals. The temperature of the metals causes the solder to flow, and, as the soldering copper is moved along the seam of the joint, it irons the metals together.

SOLDERING WITH SOLDERING COPPER



Another method, and the most common of heating the primary metals, is that of using a *soldering torch*. There are several kinds of torches (gasoline, natural gas-oxygen, natural gas-compressed air, air-acetylene and compressed air-acetylene). The basic principle of all torches is the same; to provide a heat source.

As with all types of soldering, the surface of the metals is first cleaned. Then the flame of the torch is brought close to the surface of the metals in order to heat them. Solder is applied in small amounts to the metals and the torch is simultaneously drawn away from the surface. The solder should be smoothed by passing the flame 1/2 to 3 inches over the rough solder until it has fused with the primary metals.

Soft solder is used on a number of metals, including ferrous (iron-containing) metals, copper and brass. Soft soldered joints are used in air conditioning, sheet metal, plumbing, refrigeration and electrical industries. Because soft solder is not strong, it should be used with some sort of overlapping lock seam.

SILVER BRAZING

Silver brazing is soldering using a silver alloy solder. Because the main element of the alloy is silver, and because silver has a high melting point, temperatures over 800°F are needed to heat the primary metals. Remember, soldering and brazing both require a melting point over 800°F. Silver brazing, or hard soldering as it is sometimes called, is done by the same techniques as soft soldering. It is used to join copper, brass and most ferrous materials. Silver brazing is widely applicable to the jewelry industry. Because it produces very strong joints, it is also used in air conditioning and refrigeration.

BRAZING

Brazing is similar to soft soldering and silver brazing in techniques used. The difference lies in the kind of solder used — this time, copper alloy. Copper alloys, like silver alloys, require primary metal temperatures of over 800°F. The most commonly used alloy is brass, which is copper alloyed to zinc. Another one is bronze, which is copper alloyed to tin. A term for brazing alloys is *blazing rods*. Brazing is important because of the strong joints that can be made. It is used in jewelry making and industrial processes.

Summary

In any soldering operation there are several basic steps which should be remembered:

- The metals to be joined should fit together well.
- The metal surfaces should be clean.
- There should be no dirt or grease on the metals.
- Emery cloth, steel wool, wire brush, or a good file will do an excellent cleaning job.
- Proper flux should be applied to remove the layer of oxidation which covers the surface.
- Apply the heat to the metal and let the solder flow to the joint. The solder will flow when the metal has reached the proper temperature.
- Do not overheat or underheat metals to be joined.
- Wipe all joints clean after using acid fluxes.

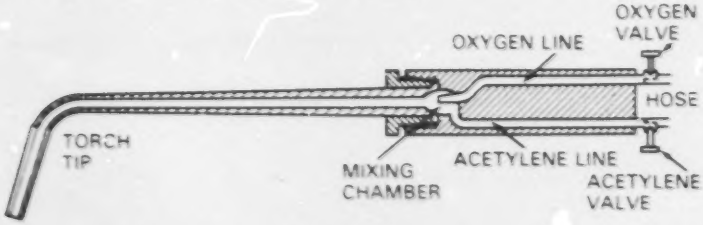
Here are some practice situations and from them you should be able to develop some conclusions of your own about soldering and brazing.

1. Pinch or cap a piece of copper tubing about 12 inches long. Leave one end open and place in vice, open end up. Fill with water and prepare end for soldering a copper fitting. Apply heat. Your conclusion. _____
2. Make a solder joint in a cramped or tight area between wall studs. Can solder run up hill? What about safety considerations? Your conclusion. _____
3. Make a soft solder test joint of two pieces of swedged copper tubing. Cut and tear apart the joint after the joint has cooled. Observe solder in joint. Your conclusion. _____
4. Braze two dissimilar metals together. Your conclusion. _____
_____.

Welding differs from brazing and soldering in that it joins pieces of metal together by melting and fusing together their adjoining edges. Filler metal is usually added to the puddle of molten metal.

OXYACETYLENE OR GAS WELDING

Many welders consider this to be the most basic welding process and the easiest to learn. An oxyacetylene rig generally includes a storage tank for acetylene gas, another tank for oxygen gas and valves and pressure gauges on both tanks to measure and regulate the flow of gas. The gases are carried to the torch by rubber or plastic hoses and mixed in the torch itself. The torch is a metal instrument which contains a nozzle, an on-off lever and adjustment knobs which control the exact mixture of gases which flow to the nozzle. A mixture of acetylene and pure oxygen is used. This mixture gives a much hotter flame (hot enough to melt steel) than does an acetylene-air mixture.



In preparing to weld with oxyacetylene equipment, a proper-sized tip should be selected. If too small a tip is chosen, there will be too little heat generated to melt the metal; if too large a tip is used, the weld will have to be made too fast. Welding torch tips

are numbered from one to eighty. The smaller the number, the larger the tip and the gas opening, which results in a hotter flame.

Two types of torches are used in oxyacetylene welding: One, called an equal pressure torch, uses equal pressures of oxygen and acetylene; another, uses high oxygen pressure and a low acetylene pressure. No matter which type of torch is used, there are three types of flames which can be obtained. They are: (1) a neutral flame; (2) a carburizing flame; and (3) an oxidizing flame.

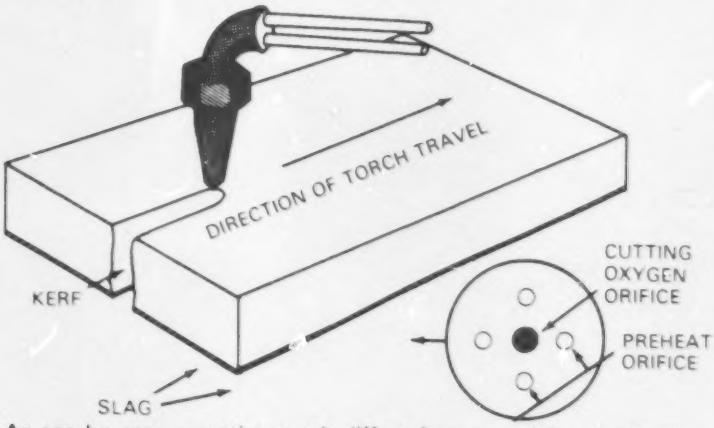
A neutral flame is one in which a proper balance of oxygen and acetylene are present. Such a flame generally burns at around 6300°F. Neutral flames are used for welding steel and cast iron. *A carburizing flame* has a slight excess of acetylene. *An oxidizing flame* contains higher quantities of oxygen and tends to oxidize (or form chemical compounds of oxygen and metal) with the metals being welded. For most welding operations, a neutral or slightly carburizing flame is desired.

The welder applies the torch flame to the plates to be welded and moves the torch in a circular motion until the metal melts and displays a smooth, glossy surface. The puddle formed is called a bead. Usually it is about 1/3 to 1/2 inch across. In many other welds, the melted metal in the pieces to be joined is not sufficient to create a strong, lasting joint. For this reason, metal from a metal filler rod is frequently added to the joint just as in brazing. Filler rod metal is added to make the joint both deeper and stronger. When using a filler rod, it is usually held near the torch flame so that it will preheat; then it is dipped into the puddle which melts it immediately. If it is held too close to the torch flame it will drip and spoil the weld. On the other hand, if it is held too far away from the flame, it will chill and harden the puddle when it is inserted. In either case the weld is spoiled. Likewise when puddling, the welder must be very careful to penetrate the metal deeply enough so that the entire adjoining surfaces of the metals fuse, and yet not so deeply as to burn a hole through the plates. Usually just enough filler is added to provide a slight crown to the weld. There should be no sharp division between the welded area and the parent metals. To be considered skilled, a welder should be able to move the filler rod and the torch in harmony with one another.

Oxyacetylene Cutting

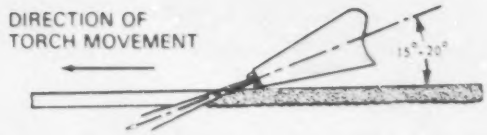
Oxyacetylene welders not only join pieces of metal together but they also cut them apart. Although welders use both oxyacetylene and electric arc cutting devices, oxyacetylene cutting is more common than any other. The flame of the torch is used to heat the part of the metal to be cut. Once it is heated, a blast of pure

oxygen is blown through a nozzle on the torch. When the oxygen strikes the red hot metal, the metal catches fire. Most metals, iron and steel particularly, will actually burn if they are heated and placed in a pure oxygen atmosphere. The heated part of the metal that was hit by the oxygen burns away leaving a hole or a cut in the metal.

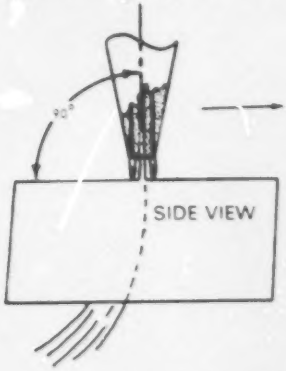


As can be seen a cutting torch differs from a welding torch. The cutting torch has an acetylene valve and an oxygen valve just as the welding torch. These valves mix the gases which provide the torch flame. In a cutting torch however, there is a second oxygen valve which is opened and shut by a spring-controlled lever. It is this valve which controls the oxygen flow and does the cutting. On the cutting torch tip there is the nozzle, or nozzles, which carry the gases for the flame and a second fairly large hole, or holes, in the tip which carry the oxygen for cutting.

Once cutting is actually begun, there are several different things which determine the width of the cut; its roughness or smoothness. First, the pressure of the cutting oxygen and the size of the hole through which the cutting oxygen flows will both affect the cut. The speed at which the cutting torch moves across the metal, and the size of the heating flame, will determine how wide and deep the final cut will be. Finally, how far the preheat flame is from the metal and the angle at which the torch tip is held, will determine how the cut finally looks. For instance, a cut which widens out as it penetrates the metal until a "bell" is left at the bottom, is probably made with too much cutting oxygen. If the cutter moves the torch too rapidly, the bottom of the metal will not be cut. However, because the gases from the flame do not have anywhere to go, their flow in the cut groove will be very turbulent. This turbulence will leave a very rough edge on the cut.



On very thin steel, 1/8 inch or less, the torch should be pointed in the direction in which it is moved, rather than holding it directly over the metal, perpendicularly. On thicker steel, more than 1/8



inch in thickness, the torch is usually held above the metal, vertically. The metal is first heated to a dull cherry red. Then the lever for the cutting oxygen should be pressed. The oxygen blast will burn away the red hot area. Very often on thick steel, the cutter will nick the edge where the cut is to be made with a cold chisel. The nick will heat, burn quickly and begin the cut. Sometimes a welding filler rod will be placed under the preheating flames. Such a rod will become red hot and burn rapidly when the cutting oxygen is turned on. As it burns, it will speed up the heating and cutting process on the steel plate. Many times oxyacetylene cutting torches are used to cut pipes. Cutting pipes requires special procedures. On small diameter pipe the torch tip is tilted in the direction in which the cut is going. This means that the flame and the oxygen blast will blow across, or tangent to the pipe, rather than toward its center. With pipe of less than 4 inches in diameter, there is a tendency for the cutting flame to burn through both walls of the pipe at the same time. This will produce a very rough cut. On pipe larger than 4 inches, the torch is pointed directly toward the center of the pipe. This position gives a very clean, neat cut.

Sometimes oxyacetylene torches are used to cut holes in metal plates. To do this, the torch is held firmly over the plate, and the oxygen is turned on slowly. The torch nozzle is raised to keep it

from being splattered with bits of slag. Much the same procedure is used when cutting rivets.

Sometimes the welder will need to cut a groove in a piece of metal. This is similar to cutting except that the welder uses a low pressure heating tip and the cutting oxygen flows out under less pressure. The oxygen penetrates more slowly and burns away less metal. Otherwise, the process is like the cutting process.

Skilled oxyacetylene welders may find jobs in a wide variety of industries welding pipe, metal tubing, sheet metal, rods and other metal forms. In addition, oxyacetylene equipment is used in many automobile and agricultural implement maintenance shops; plumbing and pipefitters may use gas welding as well as small metal repair and fabrication shops.

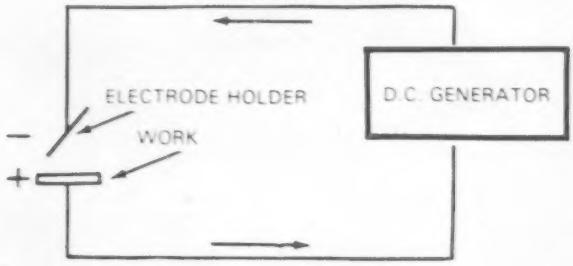
ARC WELDING

This welding process uses a flow of electrical current from a metal or carbon rod to the grounded metal plates being welded. Heat is created to melt and fuse the metal pieces being joined. As electricity flows, intense heat is generated at the point of contact of the electrode and grounded metal to be welded.

All welding requires heat to fuse the metals to be joined. Heat was created in oxyacetylene gas welding by igniting a mixture of oxygen and acetylene gas and then forcing it through a nozzle. Heat for arc welding is supplied by electricity. Electricity produces great amounts of heat when it comes into contact with metal.

Imagine that you have two metals to be joined. The metals are connected to the machine which will produce the electricity. A metal rod, which is also connected to the machine, is brought into contact with the metals. The electricity is then generated in a circle, or circuit, from the machine, to the rod, to the metal and back to the machine. (The process can also be reversed.) The rod, or electrode is lifted from the metals, and since the electricity will

ARC WELDING CIRCUIT



complete the circuit if the rod is not too far from metals, the electricity jumps from the electrode to the metal. This is called the arc. From the electrode to the point where the arc hits the metal great heat is produced. This heat melts the electrode and fuses with primary metals giving the weld. The melting electrode acts as metal filler to strengthen the weld.

DC Electricity

As just described, the electricity flowing in a stream or "current," was flowing directly; that is, it was flowing in one direction at a time. This is known as direct current electricity, or, more commonly, DC. DC is the type of electricity normally produced by a generator, and driven by a gasoline or electrical engine. When electricity flows from the electrode to the metals, it is called *straight polarity*. When the electricity flows from the metals to the electrode, it is called *reverse polarity*. As indicated, a DC generator can supply electricity of either polarity. The polarity is important, because it determines where the point of greatest heat between the electrode and the metals is located. When straight polarity is used, more heat is produced at the weld and less in the electrode; with reverse polarity more heat is produced in the electrode than in the weld. In most situations straight polarity is used because more melting action is needed on the metal to be welded than on the electrode.

The reversibility of polarity is a good advantage of a DC generator. Also, it is fairly easy to create an arc with DC. On the other hand, DC electricity has one major drawback. At any source of electricity, a magnetic field is present. Magnetism disturbs the current as it flows in either direction. Because the current is steady in one direction, the magnetism is concentrated at the point of contact between the arc and the metals. Therefore, it is difficult to make clean, steady welds using DC current.

AC Electricity

If the polarity of electricity can be alternated rapidly, the effect of magnetism on the current can be minimized. The arc welder has at his disposal alternating current, or more commonly, AC to perform this task.

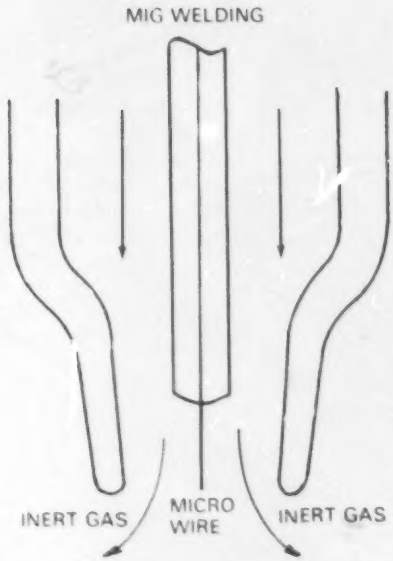
AC is the electricity produced for public consumption. It is produced by generators, and it alternates polarities 120 times per second. Thus, the heat at the metal and the electrode is nearly the same. With little magnetism, the arc welder using AC can make more accurate and cleaner welds than if he were using DC. Another advantage to AC is that the arc is easier to maintain. Of course, it has the disadvantage that the arc is more difficult to create.

For the welder who desires both AC and DC current, a transformer can be used which not only supplies AC, but also has a *rectifier,* which converts the AC to DC. A rectifier is built around a silicon or selenium crystal. This element performs the task of conversion. No matter which type of current is used, the actual welding process is almost the same. The pieces of metal to be welded are placed on a grounded metal support, or if large enough, they can be grounded directly. The electrode is then tapped or scratched across the surface of the metal, and then quickly withdrawn to form an arc. As it is pulled away, electricity flows across the gap creating an arc. The electrode is coated with flux, and, as the electrode heats, the flux coating vaporizes and creates a gas shield around the arc. The shield serves two purposes: First, it removes the outer oxide film on the metal surface; second, the gas shield serves to keep the arc directed and in place. (When arc welding is done with bare metal electrodes, the arc tends to wander.) Arc welding is used to weld a variety of metals. It is used in ship building and for welding girders in construction. It is also used in maintenance and repair shops to repair locomotives, farm machinery and tools, automobiles, factory equipment and a variety of other metal goods.

MIG WELDING

MIG is an abbreviation for "metal-inert gas." This method of welding has been developed to use shields of inert gas in maintaining the arc, instead of the electrode coating that metal arc welding uses. Inert gases are used as a shield because gases in the atmosphere combine with molten metals in the weld to form compounds which weaken the joint. Oxygen compounds, called oxides, weaken almost any joint in which they are included. Nitrogen compounds in iron and steel joints cause brittleness — the metal is less ductile (less easy to work) and has less resistance to impact. Further, traces of atmospheric hydrogen which combine in the weld can cause it to crack.

Instead of a consumable rigid electrode, MIG welding uses a consumable flexible wire electrode. As a result, MIG machine contains a wire reel and feeder mechanism, as well as a power supply and cables. It is usually trigger controlled. A MIG welding torch is less clumsy than a shielded arc welding electrode holder. A gas cable is connected from a pressure tank of inert gas to the handle so that the electrode and arc can be bathed in inert gas. The most commonly used inert gases are helium, argon, carbon dioxide or some mixture of the three. The welder strikes an arc with the torch and simultaneously bathes the weld in a shield of inert gas. Filler metal is transferred across the arc, either as a *fine*



spray or as *globular droplets*. The spray method requires high current and uses an argon or argon-oxygen gas bath. The arc is stable and can be controlled easily. Globular transfer is used at relatively low currents. A molten globule of metal forms at the tip of the electrode and drips across the arc. The arc is unstable and tends to short out as metal drips across it. Generally MIG welding uses direct current, reverse polarity.

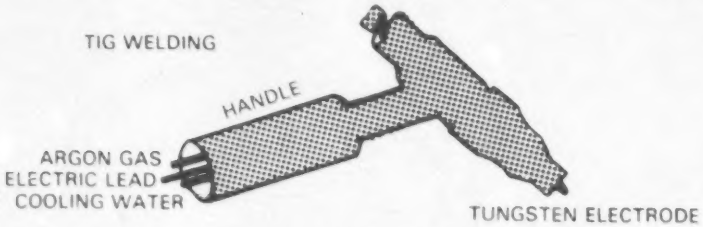
MIG welding is used in many industries. Although it was originally used on heavy structural plates, it is now also effective on very light gauge materials. Some of the industries which use it include automobile, construction, electrical, aerospace, container, piping and transportation. A variety of metals may be welded easily, including aluminum, carbon steel, low alloy steel, stainless steel, nickel, copper, magnesium, titanium and zirconium. MIG welding is used to make high quality welds at high speeds. It can be used to make long and continuous welded joints without stopping and changing rods as in a shielded arc. The training time needed to perform with MIG equipment is substantially shorter than other welding equipment. It is good for production or repetitive welding operations.

TIG WELDING

TIG is an abbreviation for "tungsten-inert gas." This welding uses a tungsten electrode shielded by a bath of inert gas. The tungsten

electrode is not consumed in the process. As a result, if filler is needed, a filler metal rod is used and hand fed into the weld in much the same way as in oxyacetylene welding.

Straight polarity in TIG welding gives deep, narrow welds; reverse polarity gives wide, shallow welds. Reverse polarity is used frequently on aluminum and magnesium. The TIG torch is very



small and easily handled. TIG machines usually have a water system that cools the torch. Gases generally used are argon or helium. TIG welding is used especially on very light gauge metal and dissimilar metal. The metals welded include aluminum, stainless steel, carbon steel, copper alloys, nickel and nickel alloys. It is often used to repair steel dies and high speed cutting tools.

GLOSSARY
WELDING

Acetylene—a colorless, gaseous hydrocarbon, produced by the action of water on calcium carbide and primarily used in the welding industry.

Air acetylene flame—a flame created by the combustion of acetylene and air.

Alloy—a material composed of two or more metals.

AC (alternating current) arc welding—a welding process that uses alternating current for its source of welding power.

Acetylene cylinder—a container specially built for the transport and storage of compressed acetylene gas.

Anneal—to soften metal by treating with heat.

Arc—a term used to describe a gaseous area or air gap through which electricity flows.

Arc cutting—producing a cut in metal by using an electrical arc.

Arc voltage—the electrical voltage at an arc.

Arc welding—a process which fuses metal together by using an electric arc to produce heat.

Atomic arc welding—this process maintains an arc between two electrodes in an atmosphere of hydrogen.

Backfire—sometimes termed a "flashback", occurs when the flame momentarily recesses in the torch tip.

Backhand welding—a gas welding technique in which the flame is directed toward the completed weld.

Backing—a material used to back up the root of a weld.

Back-step welding—a welding procedure wherein small sections of a joint are welded in the direction of the progressing weld.

Base metal—a metal to be cut, welded or brazed.

Bead—a finished weld.

Bevel—an angle cut on two pieces of base metal that are to be welded together.

Bond—the area joined together by a weld.

Brazing—a welding process which joins metal with bronze.

Build-up—amount of weld metal extending above the welded base metals.

Butt joint—the joining of two pieces of metal on the same plane.

Carbonizing or carburizing—an oxygen-acetylene flame with an excess of acetylene.

Concave weld—a weld with face below the surface of the base metal.

Cone—the conical portion of a flame near the orifice of the tip.

Continuous weld—a weld completed in one operation.

Convex weld—a weld with the face above the surface of the base metal.

Corner joint—a joint that is formed by two pieces of metal with edges touching at a 90° angle.

Covered electrode—a welding rod coated with a chemical that provides a shield during the welding process.

Crater—a depression in a finished weld.

Crown—a curved surface of a finished weld.

Cylinder—a container used to store compressed gas.

DC (direct current)—electrical current which flows in one direction.

Edge joint—a joint formed when the edges of two pieces of metal come together on the same plane.

Electrode—a material, usually a wire or rod, through which current flows between the electrode holder and arc.

Face of weld—exposed surface of a weld.

Filler rod—a metal rod which is melted into the welding puddle.

Fillet weld—a weld formed in the corner of two pieces of metal whose surfaces are at a 90 degree angle to each other.

Flash—the excess metal formed at the joint of a resistance weld.

Flux—a material or gas used to shield the puddle during welding.

Forward welding—fusing metal in the same direction the torch flame is welding.

Free bend test—a specimen weld that is bent without the use of a jig for testing purposes.

Friction welding—a process of fusing metal together wherein heat is created by revolving one metal surface against another under extreme pressure.

Fusion—the process of bonding metal together through heating.

Gas metal arc welding or metal inert gas (MIG)—a welding process which uses a continuously fed electrode in a shield of inert gas.

Gas pocket—a cavity inside a weld caused by improper welding procedures.

Gas tungsten arc welding or tungsten inert gas (TIG)—a welding process which uses a tungsten electrode in a shield of gas.

Gouging—cutting a channel in metal.

Guided bend test—a test using fixtures to bend a specimen weld at a definite place.

Heat affected zone—the area on the base metal which has been altered by heat.

Heat conductivity—heat conducting properties of any given substance.

Helmet—a hood with safety lens through which the welder observes the arc. It is designed to fit over the head and protect the face and neck.

Hose—a fabric and rubber material used to carry gas from the regulators to the torch.

Horizontal position—welding performed on base material that is positioned on a vertical plane with the passes of the weld made horizontally.

Inert gas-arc welding—this process surrounds the arc with gas and shields it from the atmosphere.

Infrared rays—heat rays that flow from an arc or welding flame.

Intermittent weld—a weld which leaves part of the joint unwelded.

Lap joint—a position in which two pieces of metal overlap each other.

Layer—a weld which consists of one or more beads placed one on top of the other.

Lead wire—carries the electrical power supply from the welding machine to the electrode holder or the ground clamp.

Lens—a treated glass that protects the welder from heat, rays, glare and radiation.

MIG (metal inert gas)—gas metal arc welding.

Mixing chamber—a part of the gas welding torch where the acetylene is mixed with oxygen.

Neutral flame—a proper mixture of oxygen and acetylene for normal welding.

Orifice—the opening in a welding tip through which gases flow.

Overhead position—a weld made on the underside of a work piece placed on a horizontal plane.

Oxidizing—combining any substance with oxygen.

Oxidizing flame—a gas welding flame with an excess mixture of oxygen.

Oxygen-acetylene welding—a welding process with a heat source obtained from the combustion of oxygen and acetylene.

Oxygen cylinder—a container built specifically for the transport and storage of compressed oxygen.

Oxyhydrogen flame—a mixture of oxygen and hydrogen in a combustible state.

Pass—the progression of one weld bead on metal.

Penetration—the depth of fusion into the base material.

Percussion welding—a technique of resistance welding in which instantaneous heat and pressure is supplied to produce the weld.

Postheating—a process of heating metal for annealing or relieving stress after the weld has been accomplished.

Preheating—a process of heating metal for relieving stress before welding takes place.

Puddle—a molten pool of metal.

Reducing flame—a slight excess of fuel gas in an oxygen fuel-gas flame.

Regulators—valves which reduce cylinder pressure and keep it constant to the gas welding torch.

Reinforcement of weld—excess metal build-ups on the face of a weld.

Resistance welding—a welding method using electrical current and the resistance of metal to produce a fused area.

Reversed polarity—direct current (D.C.) that flows through the welding circuit, the electrode holder, arc and into the base material.

Root of weld—the deepest part of the weld puddle.

Shielded arc—an arc welding process using a heavy, flux-coated electrode.

Short arc—a gas metal-arc process using low arc voltage which is continuously interrupted as the electrode bridges the arc gap.

Straight polarity—direct current (D.C.) that flows through the welding circuit, base material and arc to the electrode holder.

Tack weld—small welds placed along a seam which holds the assembly together.

Throat of a fillet weld—the distance from the weld face to the weld root.

TIG (*tungsten inert gas*)—see gas tungsten arc welding.

Tip—the part at the end of a gas welding torch that the gases flow through to produce a flame. The electrodes in resistance welding are called tips.

Toe of weld—points at which the face of the weld touch the base metal.

Torch—a device used by the welder through which gases flow and are burned.

Ultraviolet rays—energy waves that are created by arc flashes and welding flames which are in the ultraviolet spectrum.

Undercut—a low place below the surface of the base metal alongside the toe.

Vertical position—welding performed on a work piece that is positioned on a vertical plane with the passes of the weld made vertically.

Weld metal—portions of metal which have been fused together through welding processes.

Welding rod—wire or rod used as filler metal in the weld.

Welding sequence—order in which parts of a structure are welded.

Weldment—an assembly of pieces welded together in unit form.

APPENDIX
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2501 N.W. 7th Street
Miami, Fla. 33125
Publication: (1) Welding Journal (Monthly); (2) Welding Handbook.

National Certified Pipe Welding Bureau
5530 Wisconsin Avenue, Suite 750
Washington, D. C. 20015

National Welding Supply Association
1900 Arch Street
Philadelphia, Pa. 19103

Welding Research Council
345 East 47th Street
New York, N. Y. 10017

SHEET METAL

INTRODUCTION

Sheet metal workers do various kinds of metal layouts and fabrication. They lay out and fabricate ducts used in heating, cooling and other ventilation systems. Others make thin metal sheets, such as cornices and rain gutters, used in roofing and siding, building partitions and in storefronts. Whatever their jobs, there are over 60,000 sheet metal workers in the country. The number is expected to grow as industry expands. Therefore, sheet metal fabrication is a valuable trade to know.

A large number of sheet metal workers have learned their trade by working as helpers to more experienced workers. However, many people within the field think that the best way to learn the basics is through a four-year apprenticeship program. This program includes both 8,000 hours of on-the-job training and related classroom instruction. In the classroom the apprentice is trained in reading blueprints, drafting and the mathematics of layout work.

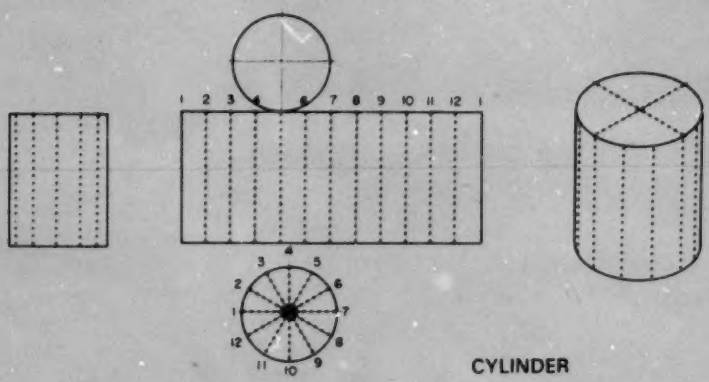
TASKS OF THE SHEET METAL WORKER

Sheet metal workers perform four distinct tasks. They layout a pattern on metal. They cut metal out of large flat sheets by using hand shears and power driven shears, among other cutting tools. Once the desired shape is cut from the metal, they shape it with a number of different machines, as well as hammers and anvils. When the metal has been formed into the right shape, it is fastened together with welds, bolts, rivets, solders or cement. These four tasks are described in detail as follows.

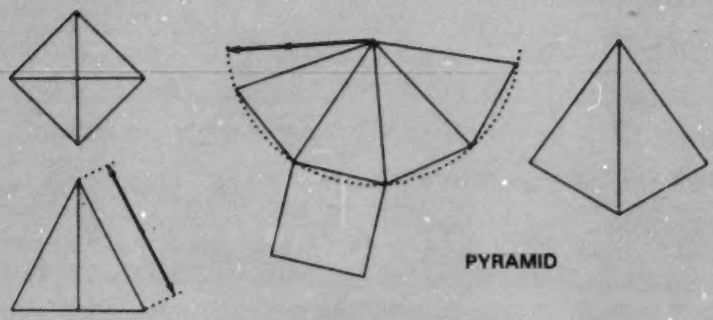
LAYOUT

Wherever sheet metal work is done, as in fabricating ducts for an air conditioning system or a rain gutter, layout work takes about half a worker's time. The other portion of the worker's time is taken up in cutting, bending and fastening.

All sheet metal fabrications are based on one or more of the basic geometrical shapes such as rectangles, cylinders and cones. The first step toward mastery of sheet metal work is fabrication of these shapes. In order to layout patterns, a sheet metal worker should know the basic blueprint symbols and how to use T-squares, triangles and compasses. A *pattern* is a drawing of the object to be made. Although the object will have three dimensions, the pattern is drawn or stretched out in two dimensions, and, therefore, it is sometimes called a *stretchout*. There are two major ways to develop patterns. One of them is called *parallel-line development*; the other is called *radial-line development*. Parallel-line developments are used to lay out patterns for prisms and cylinders. These patterns use parallel lines; the designs are formed from rectangles. Radial-line developments are used to lay out pyramids and cones. These designs are formed



CYLINDER

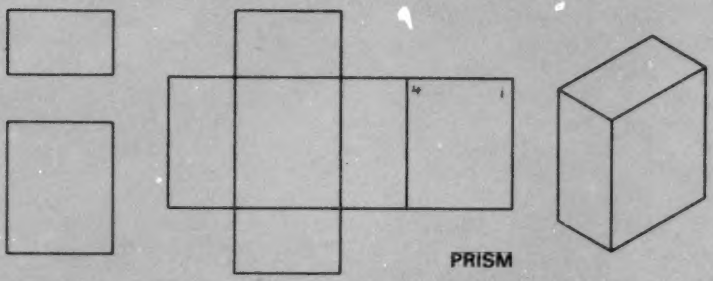


PYRAMID

from triangles. The pattern can be developed on paper and transferred to the sheet metal, but often the pattern will be drawn, or scribed, directly on to the sheet metal itself.

Sheet Metal Patterns

Let's look at some of the basic sheet metal patterns. The simplest pattern to make is the rectangle. Suppose for instance that a sheet metal worker wishes to develop a pattern for a 4 x 6 x 1 inch drip pan. The final pattern will look something like this.

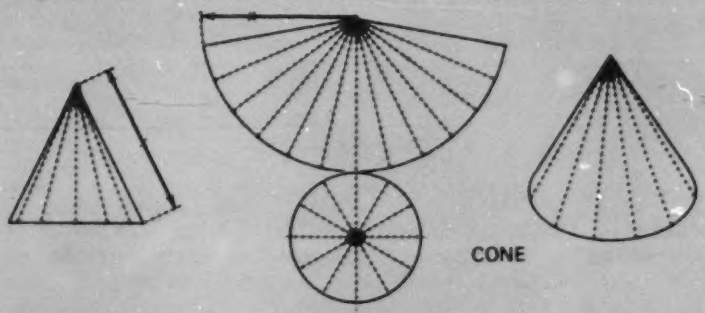


PRISM

The horizontal lines are drawn with a T-square. The vertical lines are drawn by using a triangle. Once the figure is completed the measurements should be noted. Whatever instructions, symbols or labels needed are added and the design is labeled.

Let's look at laying out the pattern for a cylinder. As with the rectangle, this is a parallel-line layout. The first thing to do is find the measurements of the pattern. To do this we need to know the height and the circumference (or the distance around) of the cylinder. The sheet metal worker finds the circumference of the cylinder, and the length of the stretchout, by multiplying the diameter of the cylinder by pi (C = pi x d). An allowance for seams is added. Once all the calculations are made, the horizontal lines of the pattern are drawn in with a T-square and the vertical lines with a triangle.

For an example of the radial-line method, let's see how a cone would be laid out. First draw an elevation view of the cone. This will be a triangle with two equal sides. The base will be equal to the diameter of the base of the cone; the height will be that of the cone. Using dividers, take the length of the side and scribe the stretchout arc. Draw a straight line between one end of the arc and the center point. Next, calculate the length of the arc. Take the diameter of the base of the cone and multiply by pi. Mark this length on the arc. Add a seam allowance.



CONE

Sometimes a rounded sheet metal figure needs to be joined to a rectangular figure. It is not possible simply to join them directly; usually they are joined to a third piece, called a "transition piece," which is rounded on one end and rectangular on the other. As might be expected, the layout of the transition piece uses a combination of the parallel-line and radial-line methods of layout. The patternmaker lays out the top view, the true length view and elevation view. Then the pattern is laid out. Finally, the amount needed for the seams is calculated and marked on the pattern.

These are the basic types of patterns. Once a person can lay out these shapes, any other patterns will only be variations of these basics.

The next thing layout patternmakers need to know is the kinds of joints, types of angles and methods of joining items. These include such joints as Tees, Wyes, Elbows, Flanges and Ogees.

The first pattern is the *elbow*. An elbow is a piece of metal which has been bent at a certain angle, usually 90° or less. There are many types of elbow joints which exist. The varieties of elbows are fairly simple to make. Let's look at the basic 90° elbow with rounded heel and throat.

To lay this out, the patternmaker first draws the heel, complete with flanges and rivet holes. The throat drawing is the same width as the heel but only about half as long. Both of these patterns are

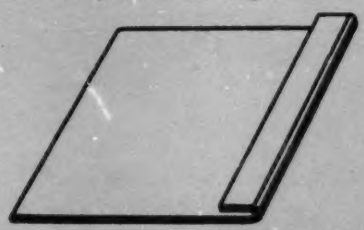
rectangles, plus flanges. The next pattern developed is the cheek view. The cheek drawing shows the type and degree of curvature in the elbow. Finally, as a last step, the pattern should include a perspective drawing showing how all the sections fit together and where the pieces should be attached to one another.

Once a person knows how to lay out elbows, there are several other joints which become fairly easy. These joints include the *tees* and *wyes*. Basically, a tee joint looks like the letter T; the wye joint looks like the letter Y. Tee joints can be made at different angles, but usually they are made at either 45° or 90°.

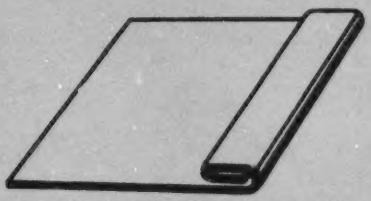
It is important to know how to lay out flanges. *Flanges* are rims or collars attached to pipes and duct work. The flange allows pipes or ducts to be bolted or riveted together. Flanges may be flat or attached at an angle. Bolt holes are usually placed an equal distance apart around the flange. The sheet metal worker must calculate how far apart the bolt hole centers should be. A typical problem might be laying out a flat-faced flange. The first step is to strike the vertical and horizontal center lines. Then mark the center point at which the horizontal and vertical lines intersect. Once the center is located, the inner and outer diameters are marked with a pair oair of dividers. The center point of the first bolt hole is marked. Next the distance from the center point of one bolt hole to the center point of the next is determined. This will depend on the number of bolt holes needed and the distance around the flange. To calculate this distance divide two times the number of bobolt holes needed into 360°. This will be angle A. The sheet metal worker then finds the sine of angle A in a trigonometric table. The sine of angle A is multiplied by the radius of the circle that runs through the bolt hole centers. Once the bolt holes have been found and marked off, the flange has been laid out.

Sheet Metal Seams

There are a variety of seams by which separate sheets of metal may be joined together. The simplest seam, the one from which all the others are developed, is the *single seam*. A single seam is

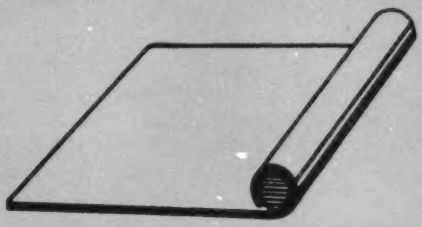


simply a flap of metal which is folded back onto the metal sheet. Usually the flap is no greater than 1/2 inch wide, although the heavier the metal the wider the flap will usually be. A similar flap is made on the sheet to adjoin it. The two flaps are laid down and pressed together. Once the seam is made, it is fastened by rivets or solder. A *double seam* is similar to a single seam except that it



is folded over twice. A double seam is used on those joints that need extra strength, or where a smooth surface on both the outer and inner folds is needed.

On some sheet metal objects a *wired edge* is used. This edge is formed by wrapping or folding the raw edge of the sheet metal



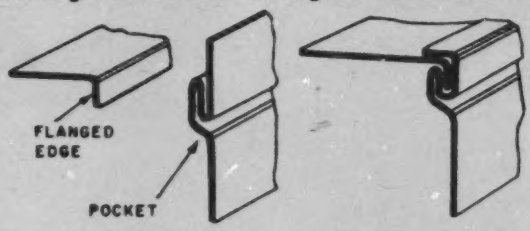
over a wire. A wired edge makes the object stronger and stiffer. It also gets rid of the sharp edges found on raw sheet metal. When laying out a wired edge, usually an allowance is made for an edge of 2-1/2 times the diameter of the wire used. If the edge is to be folded over wire 1/4 inch in diameter, then 2-1/2 times 1/4 inch would mean an allowance of 5/8 inch for the raw edge.

Grooved seams are usually single seams. A groove or hollow is pressed into one of the sheets so that the fold of the adjoining piece fits exactly into the groove formed.

During layout an allowance is made for three times the width of the final seam on the two sheets which will be joined. Each sheet will have 1/2 of this. If the the grooved seam is going to be 1/4

inch wide, the total amount of sheet metal to be allowed for is 3/4 inch or 3 x 1/4 inch. Half of this (1/2 x 3/4 inch) will be the allowance on the edge of each sheet.

Once these seams can be laid out, the next layout process to learn is the *Pittsburgh lock seam*. Pittsburgh lock seams are somewhat



similar to grooved seams but more elaborate. These seams are used to hold together boxes, rectangular ventilators, elbows and other objects made from sheet metal. There are two parts to such a seam—the flanged edge and the pocket. The flanged part is simply a narrow strip bent at a right angle to the metal sheet. The pocket is the part which locks the flange in place. The flanged edge should be narrower than the pocket. Once the flange is inserted it is locked in place by making a groove beneath the flange. In laying out the pocket, the formula is twice the width of the flange plus 3/16 inch.

CUTTING

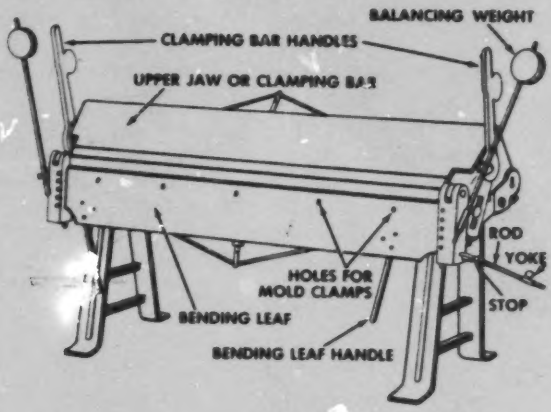
Once layouts have been drawn on paper, they are traced onto the sheet metal with scribers. A *scriber* is a sharp, pointed piece of metal which is held somewhat as a pencil. It is pressed onto the metal and the lines are inscribed. Then the pattern is ready to be cut out with shears. There are two types of shears—*circular shears* and *combination shears*. Straight lines are cut with combination shears; circular shears are used to cut out curved sections. *Hawk-billed snips* are used to make cuts inside a sheet of metal. Usually shears are held at right angles to the metal to be cut. The shears should not be closed completely when making a cut because that would leave a jagged edge. When a circular opening is to be made, a hole is first made with a punch in the area to be cut out. Then the metal is cut in a curve to complete the opening. A variety of power operated shears are used in production work where many sheets of metal must be cut rapidly.

BENDING

After the design has been cut from the metal sheet, it needs to be formed into the desired shape. A wide variety of devices exist for bending and forming sheet metal. For instance, cones and

cylinders are formed on *slip roll forming machines*. These machines may be adjusted to produce different sized curves. Most slip roll forming machines have three rollers. The metal is held in place between two front rollers and the metal is formed into a curve by being bent around a rear roller. The rear roller may be adjusted to produce different sizes of curves.

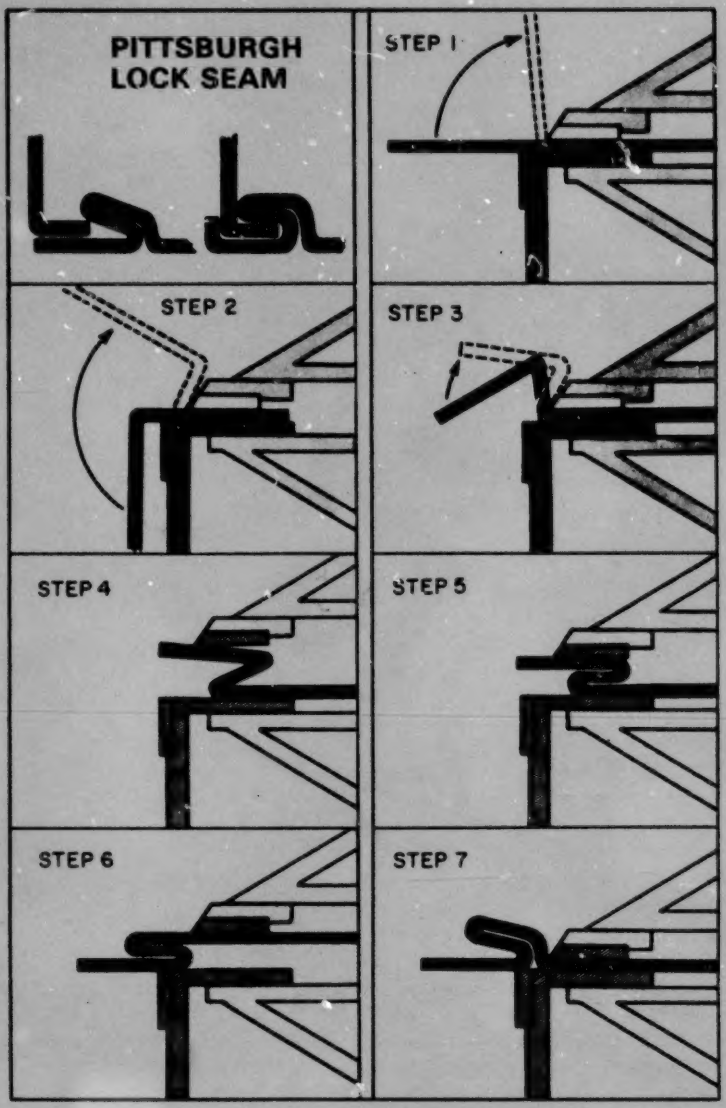
Cones may be formed by setting the rear roller at an angle before feeding the metal into it. Other bends and metal formations are made on *cornice brakes*. Cornice brakes are used to create sharp, even bends in a metal sheet. On such a machine many feet of sheet metal may be bent at one time.



The cornice brake is adjusted to suit the strength of the sheet metal being worked and set for the correct bend allowance. Once the machine has been set, the surface of the sheet metal should be scribed at the exact point for the bend. The metal is then inserted into to the brake. The bend is made by raising the leaf to the angle desired. The cornice brake is used mainly to make single hems, double hems and lock seams.

Let's see how *single hems* are formed. The sheet is first inserted into the cornice brake as far as possible. The lower leaf is then raised as far as it will go. T The sheet is removed, turned around, and then reinserted into the brake. The upper jaw is pressed down by hand to close the hem. (A Pittsburgh lock seam is basically formed by making several single hems in sequence.)

Another machine somewhat similar to the cornice brake is the *bar folder*. The bar folder is also used to make sharp bends and folds in sheet metal. The width of the bend can be adjusted with a device called a depth gauge. The wing is the part of the folder which presses down on the sheet metal to form the fold. The


PITTSBURGH
LOCK SEAM
STEP 1
STEP 2
STEP 3
STEP 4
STEP 5
STEP 6
STEP 7

sharpness or smoothness of the curve depends upon how the wing is adjusted—whether it is close to or away from the body of the folder.

Another machine used in making sharp bends in sheet metal is the *box and pan brake*. It is used to form boxes and multiple bends in sheet metal. The upper jaw has several blocks which can be removed to allow a box to be formed on it.

FASTENING

Once sheet metal has been formed, the next operation is to fasten it. There are a number of different ways that are used. Screws or rivets are commonly used. Before rivets or screws are attached, holes are punched in the sheet metal with a hand punch or a drill.If screws are used, a hole is drilled, the screw is inserted and it is fastened with a nut. On many jobs sheet metal is riveted. Rivets are metal spikes which come in a variety of sizes and shapes. No matter what size rivet is used, there are three parts to the operation—drawing, upsetting and heading. A tool called a *rivet set* is used. This has a drawing hole, which is slightly longer and wider than the diameter and length of the rivet, and a heading surface which is a concave depression. The first step is relatively simple. The rivets are pushed through the holes and the workpiece is placed on the workbench. The drawing hole is placed over the rivet. The rivet set is lightly tapped with a hammer, pressing or "drawing" the sheets together. The next part of the job is called "upsetting" the rivet. The riveter taps the rivet with a hammer. This will slightly flatten the tip of the rivet and begin forming the rivet head. Finally the rivet is headed. This is done by placing the heading die of the rivet set over the upset part of the rivet. A hammer blow or two will form the head. Pop rivets are often used where the worker cannot reach both sides of the sheet metal. There are two basic types of pop rivets—open ended and closed ended. Both are set with the same tools, which are very light and easy to handle.

In addition to rivets and screws, sheet metal is often fastened together by spot welds, especially in production processes. Spot welding uses the resistance of the sheets of metal themselves to generate the heat which will melt the metal and fuse the sheets together. There are several devices which may be used in spot welding. Some machines make a single weld at a time; others make several welds at the same time. In either type of machine, two electrodes, one on top and the other exactly underneath it, press the sheets of metal together. As they are squeezed, a high amperage low-voltage current passes between them. This heats the metal, until it is hot enough to melt, and the two sheets fuse together.

Solder is also used to fasten sheet metal together. Soldering is often used to fill seams. Other times it is used to fasten lap joints together. In either case, the instrument used for this is called a *soldering copper*. A soldering copper uses electricity to heat a hand-held copper bar which melts solder and spreads it along the metal sheets. When two sheets of metal are soldered, they are first overlapped. Next, flux is painted onto the metal to remove the oxidation film. Then the sheets are tacked together with drops of solder. Finally, the space between the drops is filled in and smoothed over with a soldering copper.

Sheet metal can also be brazed or welded. *Brazing* is a process similar to soldering in which two sheets of metal are joined together by having a third metal, a filler metal, melted between them. The two metals themselves are not melted in the process. Brazing is normally done with an acetylene or oxyacetylene torch. Sheet metal welding usually uses a lap joint. The sheets to be melted are re-overlapped. Then passes are made with the welding torch. The weld is made as on thicker metal.

Although metal-inert gas welding can be used to weld sheet metal, tungsten-inert gas welding is especially good for joining light gauge metals. TIG may be used to make both lap welds and spot welds. It uses a very small, light, easy-to-handle torch. The heat is provided by a light, rather thin tungsten electrode which is surrounded or shielded by a flow of inert gas-argon, helium or a mixture of the two.

TIG spot welding is different from ordinary spot welding, because it does not require the welder to work both sides of the sheet metal. For this reason, it can be used in many places where ordinary spot welding could not. The torch for TIG spot welding has an electrode which pulls back about 1/16 of an inch when it is turned on. The electrode is placed against the sheet metal. The trigger which turns the torch on is pressed. An arc forms. Almost immediately, the trigger is released, the torch is removed, and the spot weld has been formed.

These are the major activities sheet metal workers do; lay out designs, cut, bend and fasten sheet metal.

GLOSSARY
SHEET METAL

Acid, hydrochloric—an acid used for fluxing purposes during soldering procedures.

Acute angle—any angle that is less than 90 degrees.

Alloy—a mixture of two or more metals.

Aluminum—a soft, grey metal that is alloyed with copper, iron, silicon and manganese to make a usable sheet metal.

Annealing—application of heat to soften brittle metal.

Apex—the point where the curved surfaces of a cone meet.

Arc—any part of the circumference of a circle.

Band saw—an upright saw with a band blade welded and mounted on a drive and idler wheel. Cutting is performed by pushing work into the blade across a steel table.

Bar solder—solder molded into alloyed bars of 50 percent tin and 50 percent lead or 60 percent tin and 40 percent lead.

Beaded dovetail seam—a flange connection to a tube utilizing a bead near the end of the tube and a dovetail on the end. The flange rests on the bead, and the dovetail applies pressure to the flange.

Bench machines—a group of machines used for burring, turning, wiring, crimping and beading operations.

Bench standard—a support for a bench machine.

Black iron—an uncoated, hot-rolled, mild steel sheet that is available in standard gauges.

Blind edge—an edge preparation used when sheet metal is applied to wood. The edge is designed to cover nails and the raw edges of the sheet metal.

Brake—a machine used to bend sheet metal. A bend in sheet metal is also called a brake.

Bumping—a process of hammering metal into curved or elliptical shapes for ornamental work. It is also called raising.

Burr—the edge of a sheet metal disc that has been turned up; a rough edge of sheet metal that is left after being punched, drilled or cut.

Cadmium—a metal coating on iron used to prevent corrosion.

Circumference rule—a 36 inch or 48 inch steel rule used to determine circumference of circles.

Clearance—extra space deliberately left between assemblies to allow easy fitting.

Clip, government—a seam that is used in connecting two sections of duct.

Conductor—a tube used to carry rainwater from the eaves trough to the ground or sewer. It is also called a downspout.

Cone—a three dimensional object having a circular base and a curved surface joining at a point called an apex.

Copper—an element in the metal group that is typically red in color. It is used extensively in sheet metal work although it is quite expensive.

Cornice brake—a floor machine used for bending and folding metal.

Crease—a slight bend of sheet metal made in a brake in order to increase the metal's rigidity and stability.

Crimper—a bench machine or hand tool designed to make small corrugations in metal.

Diamond point chisel—a chisel used for cutting V shaped grooves and for chipping corners.

Dimension lines—lines with arrows on the ends that indicate the size of an object.

Dividers—a layout tool used to space off equal distances, divide lines into equal parts, transfer dimensions and scribe arcs.

Dipping solution—a solution used to clean hot soldering irons (soldering coppers). It consists of 1/2 ounce of powdered sal amoniac in a quart of water.

Double cutting shears—snips that are designed to cut light weight tubing.

Double hem—a single hem that is folded twice.

Double seam—a seam connection used to construct square pipes and boxes, and a method of fastening bottoms onto cylindrical containers.

Double seaming machine—a bench machine used to construct a double seam.

Dovetail seam—a method of attaching a flange to a pipe.

Drafting board—a drawing board where preliminary layout computations and drawings are performed.

Drive dip seams—a method by which two pieces of duct are connected.

Duct—a round or rectangular sheet metal, plastic or fiber glass pipe used in the transmission of air.

Edge, blind—see blind edge.

Edge, capped—an emergency method of covering a raw edge.

Edge, double hem—see double hem.

Edge, folded—see single hem.

Edge, wired—a method of folding an edge of sheet metal so as to install a wire within.

Elbow—a duct fabricated in such a way as to divert air or gases in another direction.

Elbow edging machine—a bench machine used in the construction of an elbow.

Electric soldering iron—a soldering copper with a heating element that uses electric current to attain heat for soldering.

Ellipse—an "egg-shaped" figure.

Exotic metals—metals that are relatively difficult to manufacture, require special fabricating procedures and are usually very costly compared to other commonly used metals.

Extension lines—extensions of drawn figures that accompany dimension lines to show sizes of objects.

Files—any of several types of toothed tools used for the smoothing or removal of metal.

Flux—a chemical that is applied to metal during soldering or brazing procedures for cleaning and prevention of oxidation of the base metal.

Flange—usually an attached or formed 90 degree edge of an assembly.

Flat cold chisel—a flat bladed, metal cutting chisel with a 70 degree angle on the point.

Flat file—a fast cutting file that has a broad flat surface.

Flat-nosed pliers—pliers with flat-bladed jaws used for small bending operations.

Flat seam—a joint of two pieces of metal that lap and are normally connected by soldering, riveting or spot welding.

Folded edge—a metal edge that is turned 180 degrees and left distinctly rounded at the fold.

Folder, bar—a bending machine used to fold metal edges.

Forming machine—a roll-type machine used to form cylindrically shaped products.

Gauge—a thickness standard used for sheet metal stock.

Galvanized—a zinc coating applied to sheet iron.

Gas furnace—a small furnace used to heat soldering coppers.

Gasoline fire pot—a portable, gasoline-powered open furnace used to heat soldering coppers.

Grooved seam—a joint connection between two pieces of metal that is locked into position with a hand or power groover.

Groover, hand—a tool used with a hammer and bench stake to complete the locking of a groove seam.

Grooving machine—a bench machine used to make a groove seam.

Hacksaw—a frame-type saw with interchangeable blades used for cutting metal that is too heavy for snips or bolt cutters.

Hammer, mallet—a wooden or fiber hammer used to form metal without defacing the surface.

Hammer, riveting—a steel hammer with a curved face and double-tapered peening end.

Hammer, setting—a flat faced, single tapered peen hammer used to set seams.

Hammer, raising—a round-headed hammer used for bumping and raising operations in ornamental and cornice work.

Hammer, ball peen—a round hammer with a curved face and round peening end. It is usually referred to as a machinist's hammer.

Hand dolly—a stake with a flat face and two straight edges and one convex and one concave edge. It is designed to be held in the the hand.

Hand lever punch—a mechanical, lever-action punch used to make holes in light to heavy gauge metal.

Handy seam—a longitudinal joint between two pieces of metal that does not require a hand groover for completion.

Handy seamer—a flat-bladed hand tool used to bend metal.

Hawkbill snips—metal shears designed to cut curves or scrolls.

Hollow punch—a punch designed to cut holes in sheet metal.

Hollow mandrel stake—a bench stake with a long rounded horn on one end and a flat, rectangularly-shaped horn on the other. It is used in making laps, riveting and seaming pipes.

Knife file—a file used for finishing sharp corners of grooves and slots.

Lead—a heavy metal element that is alloyed for soldering. It may be used in sheet form for roofing and shower pans.

Lines, brake—scribed marks on metal indicating where the metal shall be bent in the brake.

Lock, Pittsburgh—a type of joint used to close a rectangular or curved portion of an assembly such as a duct or a box.

Marking gauge—a shop-made gauge used to scribe a line at a set distance from an edge.

Micrometer—a caliper-type instrument used to measure thicknesses of metal to 1/1000 or 1/10,000 of an inch.

Mill file—an all-purpose file adapted especially to finishing.

Miter—the intersection of two round pipes.

Miter line—a layout line on a pattern which represents the joint intersection between two round pipes.

Molybdenum—an alloying metal for iron that adds strength, toughness and corrosion resistance.

Needlecase stake—an anvil or bench stake with a small tapered horn on one end and a small rectangularly shaped horn on the other.

Nibbler—a power-driven, fast acting punch used to cut intricate perforations in heavy metal.

Notching—the removal of excess metal at a set angle for corners and intersections of boxes and similar structures.

Obtuse angle—any angle that is greater than 90 degrees.

Offset—a connection made between two ducts that are not aligned. The layout utilizes triangulation methods.

Pan brake—a special type of metal brake used in the construction of boxes and pans.

Parallel line development—a method of layout work for the development of rectangular and cylindrical shaped objects.

Pattern—a flat metal piece developed to exact measurements that is used as a model in laying out specific shapes.

Pipe—round, rectangular, or many-sided conductors of gases or liquids.

Pittsburgh lock—see lock, Pittsburgh.

Plain forming machine—a machine used in forming cylindrical objects that has all rolls permanently housed on each end.

Power shears—an electric-powered shear used to make long, straight, rapid cuts in sheet metal.

Press brake—an electric-powered brake that has removable dies for executing specific shapes and forms in metal.

Protractors—a device used to measure angles in degrees.

Punch, center—a punch used to mark location of points and center holes to be drilled. The point has a 90 degree inclusive angle.

Radial line development—a method of layout work for the development of tubes or ducts with one end smaller than the other.

Raising—see "bumping".

Raising block—usually a wooden block with a specific concave shape on its face used with a raising hammer to shape ornamental items.

Revolving bench standard—a revolving bench used for supporting several bench machines.

Rivet—a flat-headed, round, metal fastener used in assembling sheet metal products.

Solid punch—a steel driving tool used to make small holes in metal.

Squaring shear—a foot-operated metal cutting shear used for making fast, square cuts.

Stainless steel—an alloy which usually contains iron, nickel and chromium. It is non-corrosive and is used very widely in construction application.

Stake holders—a steel plate that contains tapered receptacles for various stakes. It is also termed "stake plate".

Stakes, bench—a variety of anvils used in forming, seaming, bending and riveting various sheet metal articles.

Standing seam—a typical, water-proof joint used to connect succeeding courses of sheet metal on a roof application.

Stretchout—a development of a particular article. It is usually done on medium-weight drafting paper or sheet metal stock.

T square—a device used on drafting table. It consists of a ruler usually 2 to 3 inches in width and from 1 to 5 feet in length, with a crosspiece attached to one end of the ruler or blade.

Tinning—the process of coating a soldering iron tip in preparation for soldering.

Tongs—see "handy seamer".

Trammel points—two points attached to a movable beam used for scribing extra large arcs on metal.

Triangles—triangular-shaped instruments commonly used for drawing 30 degree, 60 degree and 45 degree angles or multiples thereof.

Triangulation—a method of developing layouts of objects whose sides are not parallel.

Turret punch—a metal punch with an upper and lower rotating table allowing for the selection of a large variety of punches and dies.

Vise clamp pliers—pliers equipped with a locking device so that the hands may be free with the pliers securely fastened to an object.

Welder, resistance—also termed "spot welder" - an electrical device used to fuse two pieces of metal together in small localized areas.

Zinc chloride—see "cut acid".

APPENDIX
SHEET METAL

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ADDITIONAL SOURCES OF INFORMATION

North American Association of Sheet Metal Distributors
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Columbus, Ohio 43212

Sheet Metal Industry Promotion Plan
Statler Hilton Hotel, Suite 312
Cleveland, Ohio 44115

Sheet Metal Workers International Association
1750 New York Avenue, N.W.
Washington, D.C. 20006

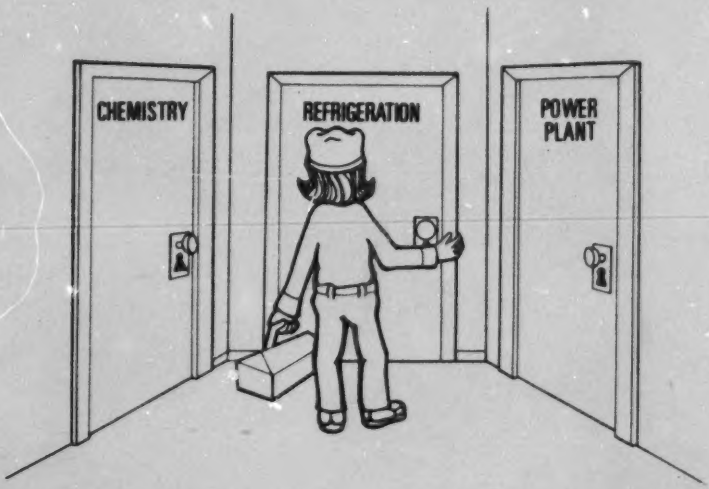
Sheet Metal & Air Conditioning Contractors National Association
1611 North Kent Street
Arlington, Virginia 22209

PLUMBING

INTRODUCTION

Plumbers and pipefitters install pipe systems that carry water, air, steam or any other liquids and gases. These systems are used for a number of purposes, such as sanitation, industrial processes, heating, cooling and home consumption. Depending on which system you work, you are a plumber or a pipefitter. A plumber installs water, gas and waste disposal systems; a pipefitter frequently installs high- and low-pressure pipes carrying gases and liquids for industrial processes.

Most plumbers and pipefitters work for plumbing and pipefitting contractors on new construction, modification and repair work. There are over 350,000 plumbers and pipefitters, and there will be more as construction activity increases. Furthermore, the chemical industry will use more pipefitting people in the future, and, as nuclear power plants expand and refrigeration systems are more widely used, there should be more jobs.



Plumbers and pipefitters may work in different areas, but they use the same basic operations: They cut, bend and fasten pipe. How these operations are performed depends on which kind of pipe is being used as the techniques used on heavy pipe will not necessarily do for light pipe, and vice versa. Let's consider ten basic kinds of pipe and the operations appropriate to each one.

CAST IRON SOIL PIPE

This is a very heavy pipe used in drains, sewers, stack and vent systems. Soil pipe comes in two weights: Service and extra heavy weight. Service weight pipe is used mainly for household drains and sewers. Extra heavy weight pipe is used in areas where its greater strength is needed to resist corrosive liquids or high stress. Soil pipe is available with an inside diameter (I.D.) ranging from 2 inches to 15 inches. It usually comes in 5 foot lengths. It is made with one or both ends shaped into a bell, and it is so designed that the end of one piece of pipe will fit the bell end of another the same size. Double belled soil pipe is made to be cut into two smaller lengths, each having a bell.

For several reasons soil pipe is popular for sewers, drainage systems and other underground plumbing. *One,* cast soil pipe is very durable. Once it is in the ground it can continue to be used for a long time, a characteristic that makes it particularly useful for sewers. *Two,* it resists corrosion. Sewage contains high concentrations of corrosive materials. *Three,* cast iron soil pipe resists abrasion and crushing. It is strong and can take heavy loads. *Four,* it does not expand or contract much when temperatures change. *Five,* it is easy to cut and fasten. It has only one weakness—it is relatively brittle. Even though it is made of metal, if it is dropped or struck by a heavy blow, it will break like pottery. This seems to be its only weakness. Unlike most other kinds of pipe, it is not weak at the joints.

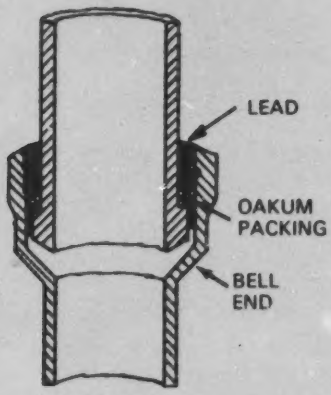
Let's look now at the processes used in working with soil pipe.

Cutting

Because it is brittle, soil pipe can be cut with a hammer and chisel. The first step in the process is to measure the pipe and to mark it with chalk or soapstone exactly where the pipe should be cut. Then the pipe is placed on a 2 x 4 block and scored with a hammer and chisel along the chalkline. The pipe is turned and struck along the scored line until the two pieces separate. With practice this process is easy to master.

Joining

There are several common ways used to join pieces of soil pipe. The most common joint is called a *caulked lead joint.* The plumber sets the hub, or unbelled end of a pipe length into the bell end of another length of pipe. Then *oakum* is twisted tight and packed into the joint with a *yarning iron.* Then molten lead is poured over the oakum until the joint is filled. Once the lead has cooled, it is tamped and caulked with a *caulking iron.* The iron is then tapped



CAULKED
JOINT

gently with a *ball peen hammer.* On some jobs lead wool is used instead of molten lead.

A *neoprene gasket joint* is used in places where rigid joints would break, such as where soil shifts very frequently. A gasket is fitted to the end of one pipe, and a stainless steel shield is placed over the end of another pipe. As soon as the two ends of pipe are fitted into the gasket, clamps are moved into position around the end of each pipe. The clamps are tightened alternately.

Sometimes a *mortar joint* is used to join lengths of soil pipe. Such joints are quickly made and last a long time. The mortar is mixed light (one part Portland cement to two parts sand) and applied with an instrument called a *pointing trowel.* After the pieces of pipe have been placed into position, oakum is dipped into the mortar and then wound tightly around the hub. Once the oakum is in place, mortar is pressed into the joint with a pointing trowel, smoothed and allowed to dry.

Soil pipe differs from other pipe in that it cannot be bent. Therefore, pipe manufacturers make differently curved lengths of soil pipe, including *wyes, tees* and *elbows.* Neoprene gasket joints are also useful where bends are needed.

Sometimes soil pipe needs to be joined to other types of pipe. When this occurs, several different joints may be made, depending on the kind of pipe that is used. A number of special devices called *adapters* are available for this purpose. One end of the adapter is joined to soil pipe with the mortar or oakum lead method; the other end is joined by whatever method is appropriate to that pipe.

GALVANIZED STEEL PIPE

Steel pipe is used widely in water supply systems and in steam heating systems carrying low-pressure steam. Black steel pipes are frequently used to distribute fuel gas under low pressure and pressurized air blown through piping systems.

Steel, or screw pipe comes in a wide variety of sizes, ranging from an inside diameter of 1/8 inch to an inside diameter of 12 inches. Usually steel pipe comes in lengths of 21 feet. It is made in three different weights: Standard, Extra Heavy and Double Extra Heavy. The thickness of the walls of the pipe vary with the weight classification and pressure requirements of the job.

Although different weights and diameters of steel pipe have varying characteristics, there are certain things common to almost all steel pipe. *One*, it resists corrosion fairly well, although hard water, strong acids and harsh chemicals cause deterioration. *Two*, it is strong. Heavy-weight pipe holds up against strong pressures, and can be used in pipelines for high-pressure gases and liquids. If it bursts from inside pressure, it usually will break at a joint, not within the pipe. The strength of steel pipe at joints can be increased greatly by welding the joints. *Three*, it can be worked easily. Steel pipe can be bent and cut easily with a pipe cutter. Further, it can be threaded and joined to another length of pipe. *Four*, steel pipe is not brittle. It can hold up under much greater loads than can cast soil pipe. For this reason, steel pipe is widely used in a whole series of places where pressure pipe is needed.

Steel Pipe

Although steel pipe may be cut with a hacksaw, it is usually cut with a *pipecutter*. A pipecutter is a device containing a very sharp wheel which bites into and cuts the pipe as the tool is turned around the pipe. As in any other method of pipe cutting, the plumber first locates and marks the exact point where the pipe should be cut. The pipe is placed in a vise to hold it firmly, and the pipecutter is rotated around the pipe. After each rotation, the pipecutter is tightened so that the wheel cuts more deeply into the metal. The plumber continues this until the pipe is cut in two.

One other device is used to cut pipe. This is an oxyacetylene cutting torch. A cutting torch is particularly useful if the pipe needs to be cut at an angle or into some unusual shape. There are two ways to hold the torch when cutting pipe. If the pipe is less than four inches in diameter, the torch should be held so that the flame blows across the top surface of the pipe while the pipe is rotated. If the pipe is thicker than four inches, the torch flame should be aimed directly toward the pipe. A much cleaner cut may be obtained if the torch is aimed directly at the pipe. On small

diameter pipe, though, there may be a tendency to burn through both walls of the pipe at the same time and create a ragged edge.

Once the pipe is cut, it is ready to be fastened. There are two ways to fasten steel pipe. It may be welded, or threaded and fastened by screwing. Steel pipe is threaded with a device called a *threading die*. The pipe is first placed in a pipe vise. Then the plumber carefully guides the cutting die onto the pipe. As the plumber puts pressure on the die, he starts to thread the pipe. Threading oil should be applied liberally after each turn of the die. When one thread extends beyond the die, the pipe is sufficiently threaded and the plumber takes the die off, cleaning the steel chips from the threads. After the pipe is cut, it should be reamed to remove the steel burrs on the inside. A *reamer* is a tool which fits the inner diameter of the pipe and removes burrs.

Once the pipe is threaded and reamed, it can be fastened with screw fittings. Although there is not room in this manual to talk about all the different screw fittings, there are some basic kinds that can be reviewed. Screw pipe fittings are grouped into unions, reducing couplings, elbows and tees, wyes or crosses. Let's talk about each of these types.

Union

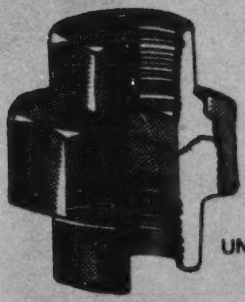
A *union* is a device which makes it possible to screw two threaded pipes or fixtures together. It contains three parts. One part is screwed onto one pipe or fixture; another identical part is screwed onto the other pipe. The outside of each part is identically threaded. The third part of the union is a nut which is screwed onto the outer threaded areas and draws the two parts together.

Reducing Coupling

Another common fitting is a *reducing coupling*. Often, lengths of pipe of two different diameters will have to be joined. A reducing coupling tapers so that pipe of one diameter can be screwed to one end and pipe of a smaller diameter can be screwed to the other end.

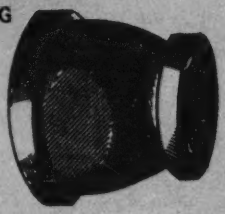
Elbow

Another simple fitting is an *elbow*. Often, pipe will need to change its direction, sometimes more sharply than it can be bent. In this case an elbow is used. An elbow is a short piece of pipe with two inner threadings which has been sharply bent, usually at either 45 degrees or 90 degrees. The elbow is attached to one length of pipe. The direction change is made by the elbow. Another length of pipe is screwed to the other end of the elbow.

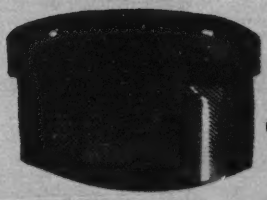


UNION

REDUCING COUPLING



45° ELBOW

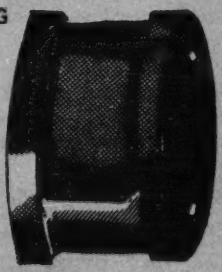


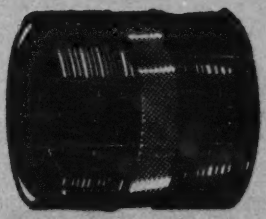
CAP

90° ELBOW

PLUG

COUPLING





NIPPLE

Tees, Wyes, Crosses

Other fittings include *tees*, *wyes*, and *crosses*. A tee and wye have three openings; a cross has four.

Bending

Generally, bending is done with a *hickey bar* after heating the area to be bent with a blowtorch or oxyacetylene torch. In bending steel pipe, plumbers must be careful not to bend the pipe too sharply, to prevent it from closing up or breaking. Mathematical tables show how large to bend a pipe according to thickness and diameter. A plumber must always be careful to check these tables before beginning a bend.

Joining

Steel pipe is often fastened by welding, particularly if it is expected to carry gases or liquids under high pressure. One advantage of welding is that pipe can be joined into any desired position or at any angle. This can be done by a machine on which either the torch flame travels around the pipe or the pipe is rotated. For more complex joints the welding must be done by hand. Because pipe is welded in different diameters and at different angles, adjustable support blocks are used where pipe is welded. If pipe is greater than 1/8 inch thick it should be *chamfered*. Chamfered pipe has a bevel along the edges which will be joined by welding. Two lengths of pipe with beveled edges are butted together and form a V-shaped joint. The V is heated and filler metal put in to produce a strong joint.

PLASTIC PIPE

Plastic pipe may be rigid, semi-rigid or flexible. Rigid or semi-rigid plastic pipe is sold in twenty foot lengths, while flexible plastic pipe comes in bundles up to 3500 feet long. This sort of pipe has a variety of diameters, starting at 1/2 inch.

Plastic pipe is valuable in several ways. It is extremely light and durable. Plastic pipe can be resistant to chemical action and corrosion. Despite this, it does not hold up well under heat and should not be used for carrying hot liquids or steam. In addition, it should not be placed where contact can be made with steam lines or other high temperature pipes. On the other hand, plastic pipe is fairly easy to work.

Cutting and Bending

Plastic pipe may be cut with a sharp knife or fine toothed hacksaw. Once it is cut, it may be bent to any broad angle the

plumber desires. This can be done by hand without special tools. Of course, rigid and semi-rigid plastic pipe cannot be bent at all. For this type of pipe a variety of elbows are available.

Joining

There are three main ways to join lengths of plastic pipe. First and simplest, two pieces may be clamped together with stainless steel clamps over a specially designed adapter. Often, however, the plumber will fasten lengths together by two other methods—heat or solvent cement. Fastening lengths of pipe together by heat is a fairly simple job. A heating coil specially designed for the job is inserted into one end of the pipe and into the fitting socket. When the pipe and the socket become soft and "tacky," the heater is removed and the pipe end is inserted into the fitting socket and twisted slightly. The pipe should be held until it cools off.

Joining plastic pipe by solvent cement has two steps. First, a solvent is added to the outside surface of the pipe. The inner surface of the fitting is also coated. This solvent softens the surface of the pipe in much the same way that heat does. The two pieces are then stuck together as if they were being joined by heat.

COPPER TUBING

Copper is usually used in tubing rather than in large pipe. Copper tubing comes in three weights—light, medium and heavy. Two strengths of tubing are available—soft and hard. Soft copper is used where the tube must be bent; hard copper where it will be exposed to rough use.

Two problems exist with copper which limits its usefulness: It is very expensive and it expands with heat. In fact, it expands about twice as much as iron or steel. On the other hand, copper has certain advantages. It is very light, it is fairly easy to work with and it resists corrosion.

Cutting

Copper tubing is cut with a *tube cutter*. This is a smaller version of the device used to cut steel pipe. The cutter is tightened around the tube at exactly the measured spot where it should be cut. The cutter is rotated around the pipe and tightened at each turn until cut.

Bending

As with steel pipe, the major problem in bending copper tubing is to make sure that the tube does not collapse or break. For this

reason, it is good to check the radius of bend in one of the plumber's handbooks before actually bending.

Joining

Copper tubing is generally fastened with *solder*—either soft or hard. Since both tubing and fitting must be perfectly clean, the rust which forms on these parts must be removed with *acid flux*. (A joint soldered over rust will be weak.) The fitting is then attached to the tube and the joint is heated with a torch. Once the solder melts and touches the heated tubing, the joining can begin. The solder is moved around the joint until the joint is filled with solder. The torch is removed and the joint is wiped clean with a cloth.

GLASS

Glass pipe is used frequently in dairy, chemical, food, paper and pharmaceutical industries. It has many features which make it attractive to these industries. For one thing, it resists corrosion. It is transparent; you can see the liquids flowing in the pipe and detect any stoppages. Glass pipe can be used under high temperatures. Further, it is smooth and easy to clean. However, there are some disadvantages. It is difficult to cut. Although glass pipe manufacturers make special kits for cutting glass pipe in the field, it is usually advisable to measure carefully the lengths that will be needed and to order the exact sizes. Further, although glass pipe is tough, it should not be placed under strain. It should never be placed in walls or underground.

Glass pipe can have its direction changed by using special fittings provided by manufacturers, although it cannot be bent easily. Connections are made by fitting both ends of the pipe into a neoprene gasket which is clamped down with a stainless steel clamp. Rubber blocks are used with one block placed at either end of the pipe. A gasket is placed in between and the whole assembly is bolted together.

LEAD PIPE

Lead pipe is normally used in short lengths to carry wastes from plumbing fixtures to cast iron soil pipe, and to drain away wastes from chemical plants. One disadvantage of lead is that it is dangerous for use in carrying drinking water. Soft water dissolves lead and lead is a powerful poison. Further, if lead piping is to be used to carry hot water, it should be installed with a board running under it; otherwise, it will soften and sag. On the other hand, this softness is sometimes an advantage—lead pipe is very easy to work.

Cutting

Lead pipe may be cut with a pipe or tube cutter, just as steel pipe or copper tubing. However, because lead pipe is so much softer, it is much easier to cut.

Bending

Lead pipe is bent with a hickey bar or bender, as are steel pipe and copper tubing. The only difference is that a spring is placed inside the lead pipe to keep it from collapsing during the bending process.

Joining

Lead pipe is usually fastened to soil or steel pipe in very short lengths. The connection is joined by a fitting called a *brass ferrule*. The ferrule is tinned with solder to ensure a bond between the metals. The joint is then soldered. A *solder nipple* is used to join steel pipe to lead pipe. The nipple is screwed onto the steel pipe. The lead pipe is fitted into the nipple and the joint is soldered.

ASBESTOS-CEMENT PIPE

Asbestos-cement pipe is made from asbestos fibers mixed with cement under high pressure. This combination of materials is very strong and lasts a long time. This pipe does not rust or corrode. It is light and has a smooth inside surface which does not interfere with the flow of liquids. It is made in three varieties depending on the amount of pressure measured in pounds per square inch (PSI) it will carry. These are 100, 150 and 200. It is sold in standard lengths of 13 feet. There are a variety of inside diameters marketed, varying from 4 to 16 inches.

Cutting

There are several ways to cut asbestos-cement pipe. Sometimes a specially designed cutter, which has a blade instead of a wheel, is used. It can also be cut with a sharp cross-cut saw.

Joining

There are a wide variety of asbestos-cement pipe fasteners available, but, usually some type of *rolling ring coupling* is used. Several steps are followed to join the pipe. First, the *sleeve coupling* is placed on one of the lengths of pipe to be joined. Second, two rubber rings are placed on the pipe at a given distance from the end. Third, the sleeve coupling is pulled toward the second pipe until it is centered over the joint. The sleeve is pulled with a special tool anchored to the second length of pipe.

BITUMINOUS FIBER PIPE

Bituminous fiber pipe is made from wood fibers which have been shredded and impregnated with coal tar pitch and heated to 340 degrees F. This type of pipe is used mainly in gravity flow sewers, however, it does not work well if subjected to pressure. This pipe comes in a variety of lengths and inside diameters. The 2, 5 and 6 inch inside diameter pipe comes in 5 foot lengths. A 3 and a 4 inch inside diameter pipe is sold in 8 foot lengths.

Cutting

Fiber pipe may be cut with an ordinary carpenter's handsaw. Before making the cut, the pipe should be carefully measured to ensure that the right length of pipe is cut. Using a *miter box* helps produce a square cut.

Joining

Lengths of fiber pipe are joined by tapering their ends. It can be ordered already tapered, but there are pipe tapering machines that can be used in the field. Once the pipe is tapered, the fitting is placed against it. A wooden block is placed on the mouth of the fitting to protect it from hammer blows. Then the block is hit with a sledge hammer, driving the fitting onto the tapered end of the pipe.

VITRIFIED CLAY PIPE

Clay pipe usually comes in short lengths. This type of pipe is used for house sewers to join plumbing fixtures inside the house to the cast iron soil pipe of the larger public sewage system. One problem with vitrified clay is that its joints are broken by tree roots and settling soil.

Cutting

Although vitrified clay pipe comes in small lengths, it does occasionally have to be cut. In this case, the pipe is carefully measured and marked. Then a brick chisel and hammer are used to make a light score around the marked spot. The scoring is repeated and deepened until finally the cut is complete. Clay pipe is very brittle and the plumber must be careful not to make an uneven cut.

Joining

Clay pipe generally comes in a *bell and spigot* arrangement similar to cast iron soil pipe. Joints are made by placing the spigot end of one length of pipe onto the bell end of another. The joint is filled

with a 3/4 inch layer of oakum which is packed down with a yarning iron. Then the joint is filled either with mortar or with a bituminous filler compound. Finally, the plumber bevels the joint with a trowel.

CONCRETE PIPE

Concrete pipe is used in a variety of situations, as in large water supply systems. The pipe comes in so many shapes and sizes that it seldom needs to be cut. However, when necessary, iron-reinforced concrete pipe can be cut in the same way as vitrified clay pipe. Usually, concrete pipe is made in a bell and spigot form. Joints are packed with oakum and filled with mortar or pitch.

A person who knows these types of pipe and how to work with them is well on the way to becoming a good plumber.

PIPEFITTING

INTRODUCTION

Pipefitters work in industry where they install high and low pressure pipes that carry hot water, steam, compressed air and chemicals. They install ammonia carrying pipes in commercial refrigeration systems, or work in the extremely complicated pipe systems of an oil refinery. Many industries, such as the chemical industry, the food processing industry, the drug industry, the paper industry and the iron and steel industry, use pipefitters to install the piping systems upon which they depend. Plumbers, on the other hand, install water, gas and waste disposal lines in homes, apartment buildings, office buildings, factories and schools.

Pipefitters often specialize in a specific type of pipe installation. Some, known as *steam fitters*, install only industrial or commercial steam and hot water lines. *Gas fitters* install only gas mains and gas extensions. *Industrial pipefitters* need to know how to install and maintain radiators, pumps, boilers, stokers, oil burners and gas furnaces. They should know about hot water, steam panel and radiant heating systems, and they should also be familiar with air conditioning, power plant piping, compressed air and piping control systems.

Although many pipefitters have learned about these systems by working for pipefitting contractors, it is possible to learn about them in a five year apprenticeship program. An apprenticeship program is carried out under a written contract between the apprentice and the local joint apprenticeship committee, which is made up of representatives from management and union. The union for both plumbers and pipefitters is the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada. An apprenticeship program includes 10,000 hours of on-the-job training and 144

hours of related classroom instruction each year. On the job, apprentices are taught how their equipment operates and how to use the tools of their trade. In the classroom, they learn to read blueprints, the mathematics of layouts used in piping systems and building codes.

Pipefitters usually work with steel pipe, and, occasionally, with copper tubing. No matter what material worked, there is always a definite procedure followed. The pipefitter must know where the pipe will go, what size it should be, how and where the pipe should be bent and how it will be joined. The pipefitter figures exactly how much pipe will be needed and how to lay out the operation. Tools and the materials which will be needed to finish the task must be secured. The tools must be in good condition and the pipe must be available in the exact quantities needed. Next, materials are worked and joined. Finally, the completed item is checked to see if it works.

These operations are common to both pipefitters and plumbers. However, pipefitters are often asked to do very complex tasks. An example would be the insertion of a small tube into a large pipe. This tube could lead to a pressure gauge. It might contain a temperature sensor and lead to a safety valve. Whatever its purpose, the tube must be installed carefully so that there is no leakage around the hole. The process is called "tapping steel plate". The pipefitter first measures and locates the exact place on the steel plate or surface of the larger pipe that the tube will be inserted. This spot is carefully marked and the hole is started with a center punch. Once a beginning has been made, it is drilled and threads are made in the hole. A *tap*, which threads the hole, is begun, and once the thread has been started, the tap is removed and the threaded tube run through. The tube is rotated and this rotation finishes the threading. If the tube threads its own hole it will fit more tightly.

A very important operation for pipefitters is the fabrication of fittings. Though ready-made fittings are available for most steel pipe which has an inside diameter (I.D.) of less than 3 inches, pipefitters often work with pipes where the inside diameter is greater. For larger pipe, fittings are usually not available from a manufacturer. The pipefitter in these cases has to make fittings. Once a person has grasped how to fabricate these, pipefitting will be relatively easy.

BULL PLUG

A bull plug is a cap welded onto the end of a pipe to cap or close it off. Fabricating a bull plug is fairly simple. It is one of the most useful things a pipefitter can know, because plugs are often

needed and are unavailable commercially. First, quarter the pipe to be closed off. To do this, wrap a strip of paper around the pipe and cut off any overlap. The edges of the strip should just meet. Then fold the paper into four equal segments. Wrap the paper around the pipe again. Mark the pipe with a soapstone pencil at each crease and at the ends. The pipe is now quartered. Now mark a straight line, about 6 inches long, from the end of the pipe through each quarter point. Number these lines: 1 and 2 on the sides, 3 on the top and 4 on the bottom.

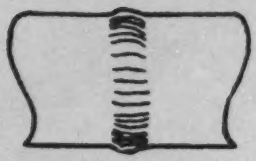
Take one-half the inside diameter of the pipe. Mark this length from the end of the pipe on lines 1 and 2; call these points A and B. Then take a *wraparound*, which is a thin, flexible strip of material about 3 or 4 inches wide with straight sides, and line the wraparound up with point A and lines 3 and 4 at the end of the pipe. Mark the curve with chalk and repeat with point B. Then take twice the thickness of the pipe and mark this distance from the end of the pipe on lines 3 and 4. Call these points C. Connect points C in a freehand curve with the curves already marked. Cut along the curve ACBCA (pointing the torch) toward the center of the pipe in a radial cut.

To lay out the cap piece of a bull plug, draw a similar curve on the side of a piece of pipe the same size as the one to be closed off. Begin by drawing a line around the pipe, called a centerline. Quarter the pipe at the centerline and draw lines through the quarter points. Number the lines 1 and 2 at the sides and 3 at the top, as before. From the centerline, mark points A and B on line 3.

Points A and B are each one-half the inside diameter from the centerline. Using the wraparound as a guide, connect point A with the intersections of the centerline and lines 1 and 2. Repeat with point B. Then take twice the thickness of the pipe and mark this length on the centerline, measuring from lines 1 and 2. Call these points C. Connect points C in a freehand curve to the curves already marked. Again using a radial cut, cut out the cap piece along curve ACBCA. Place the cap over the end of the pipe to be closed off and *tack weld*. Once the piece has been tack welded in place it is a completed bull plug.

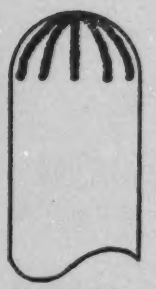
ORANGE PEEL HEAD

This is a series of cuts and folds in the end of a pipe which looks like orange segments. The orange peel head is another way of closing off a pipe. To make this head, the pipefitter first carefully measures the outside diameter of the pipe that needs to be closed off. Then a table is checked to find out how many arms, or how many segments are needed. (Most pipefitting manuals have a table which shows how many segments an orange peel head



PIPE BUTT JOINTS

BULL PLUG



ORANGE PEEL

should have, and how long each segment should be for each standard outside diameter.) The pipefitter then marks off that number of equally long segments on the outside of the pipe. Next, the distance is measured, equal to the length of each segment, from the end of the pipe. A line is drawn around the pipe at this point. Next, draw a *template*, or pattern, of a segment. A template for an orange peel head is simple to make; the pipefitter draws a straight line which is equal in length to the height of a segment of the orange peel head. This is divided into three equal parts, and lines are drawn through these points at right angles to the first line. The pipefitter checks the tables to find out how long each of the three lines should be. Lengths vary depending on the size of the pipe. Then the end points of each line are connected to each other and to the end point of the first line.

The template is now drawn and cut out with scissors. The pipefitter lays the template on the pipe, with the base of the template lined up with the base line marked on the pipe. Then the pattern is traced onto the pipe with a soapstone pencil, as many times as there are segments. Once the segments are traced the excess metal is cut away with a cutting torch. The cut is made with the torch pointing toward the center of the pipe in a radial cut. The edges of the segments are beveled at 45°. Then the arms are heated and bent together.

TEE

There are several types of tees. (Tees are made to allow another pipe to be attached so that a pipe will have two outlets instead of one.) There are two kinds of tees which pipefitters can make: A *full-size tee* attaches a pipe with the same outside diameter as the original pipe; the second kind is called a *reducing tee* and attaches a smaller pipe to the side of a larger one.

Let's first look at how a pipefitter makes a full size tee. The process is very much like that used in making a bull plug. The

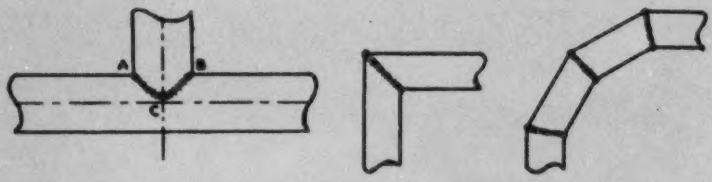
wraparound is applied to the header pipe where the tee should be attached. The pipefitter uses the wraparound as a guide to draw a centerline around the pipe. As was done with the bull plug, quarter the pipe. Draw straight lines about 10 inches long through each of the quarter points. Label the top line 3, the bottom line 4 and the two side lines 1 and 2. Along line 3, the pipefitter measures off a line equal to one-half the outside diameter of the branch on either side of the center line. Call end points X and Y and the intersections of lines 1 and 2 with the center line Z. Next the wraparound is lined up with X and the two Z points. Connect these points with a chalk line; repeat with point Y. Cut out the marked section with a cutting torch. The torch should be pointed directly at the center of the pipe to make a clean, smooth cut. When the cut is finished, bevel the sides to a 45° angle. When this is done the header pipe is ready.

The next step is to prepare the branch pipe. On the branch pipe, the outer surface is quartered at one end. Four 6 inch straight lines are drawn at the quarter points. The quarter points are numbered 1 and 2 on the sides, 3 on the top and 4 on the bottom. Mark two points M and N on lines 1 and 2; again, M and N are each 1/2 the outside diameter of the pipe away from the edge. The intersection of lines 3 and 4 with the end of the pipe is called points O at each point. Using the wraparound, draw chalklines from M and N to the two points O. After measuring and drawing the chalklines, take a cutting torch and cut away the excess. The branch is then ready to be welded to the header.

A reducing tee is more complicated than an ordinary tee. On a reducing tee the branch pipe is smaller than the header pipe. In the process just described, the branch and header were the same size. Just as with the common tee, there are two parts of laying out a reducing tee—laying out the header, and laying out the branch. First, draw the centerline around the header through the center point where the branch will be placed. Then hold the branch up at right angles to the header and centered on the line. With a sharp soapstone pencil trace the outline of the branch. From the point where the circle intersects the centerline, mark two extra points as far outside the circle as is the thickness of the wall of the header. Connect these two points to the circle. This gives the cutting line on the header. Take a cutting torch, point the tip of the flame inward toward the center of the header and make the cut.

The next step is to lay out the branch. First, cut a straight piece of wood to a chisel shape. Then hold the branch up at a right angle to the header. Hold the wooden chisel snugly to the branch, with its edge touching the side of the header. Mark off the distance

between the header and the branch on the wooden chisel. Hold the soapstone on the mark and pull them both around the header. This will mark the cut line on the branch. Then take a cutting torch and make a radial cut. The branch and header are now ready to be welded together.



ELBOW

When the pipefitter needs to change the direction of a pipe sharply, an "elbow" is used. Elbows can be made so that they change the direction of flow by almost any angle. However, the most common elbows make either 90° or 45° turns. Making an elbow is very easy no matter what angle the pipefitter wants. There is a formula for finding the exact angle at which to cut pieces of pipe which will be joined in the turn. The first step in figuring the angle is to take the number of degrees in the turn. Then the pipefitter divides this angle by twice the number of welds that will go into the turn. For example: A pipefitter wants to use two pieces of pipe to make a 90° turn. At what angle should the pipe be cut? The number of degrees in the turn is 90. The number of welds is 1. Ninety divided by 2 x 1 is 45°. So the pipe would be cut at a 45° angle. How would the cut lines for a 90° turn be laid out? First, locate the centerline of the cut and quarter the pipe. Then figure the angle of the cut using the formula in the paragraph above. Once the angle of the cut is known, check a table to find a factor for the angle of the cut. This factor is a number by which the outside diameter of the pipe will be multiplied and the result divided by two. This gives the number of inches on either side of the centerline on which the cut will begin and end. With a wraparound trace the cut line. Make the cut with a cutting torch. The cut pieces are then lined up and welded.

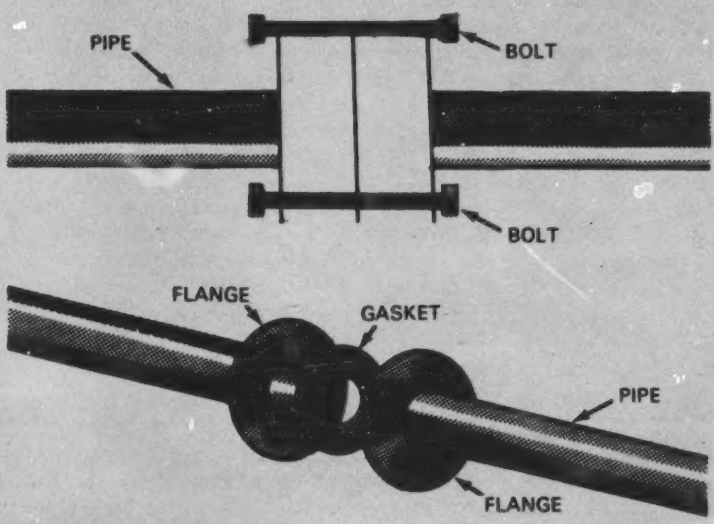
OFFSETS

An offset is a pipe layout which runs a pipeline around an obstruction. Since almost every pipeline has at least one obstruction in its path, it is necessary to be able to make offsets. Sometimes, if the pipeline needs to have its direction changed only slightly, a single offset will be enough. Other times, several offsets in combination will be required to carry a pipeline around

obstructions. Fittings are usually available, and turns can be fabricated simply enough, so the major problem pipefitters face with offsets is in figuring how much pipe they will need to travel a given straightline distance. This calculation makes use of trigonometry. Usually offsets are made at angles of 22-1/2°, 30°, 45° and 60°. Pipefitting handbooks have tables, so that if the angle of the offset and the straight line length of the turn are known, the pipefitter can find the length of pipe which will be needed for the offset.

FLANGES AND GASKETS

Flanges are outer rims welded on pipe ends so that lengths of pipe can be bolted together. Gaskets are made from a flexible material. They are used between flanges to improve the seal. The major problem pipefitters face with flanges and gaskets is in laying them out. It is more difficult to determine where the bolt holes go than it is to do the rest of the job. The first thing done is to lay out the centerlines—both vertical and horizontal. The center point of the flange is that point where the centerlines intersect. The pipefitter then takes a pair of dividers and scribes both the outer and inner diameters of the flange. The position of the first bolt hole is scribed. Once done, the pipefitter has to calculate the distance between bolt holes. In order to do this accurately, a book of trigonometric tables is needed. First, divide two times the number of holes in the flange into 360°. This gives angle A. Then take the trigonometric table and look for a value called the "sine

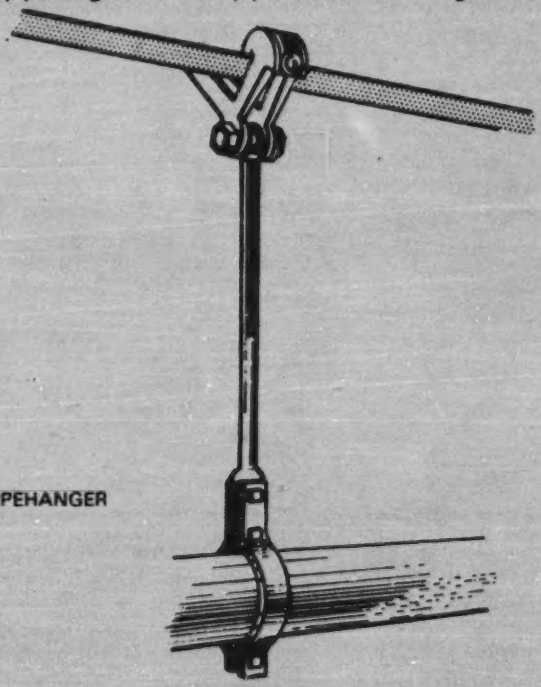


of angle A". Multiply the sine of angle A by the diameter of the bolt hole circle. This gives the straight line distance between bolt hole centers. Scribe them on the plate. Cut out the flange and drill the bolt holes. When drilling the bolt holes, be sure that they are 1-1/2 times as big as the bolts so that they will fit.

Once the flange is fabricated, it is ready to be mounted. The pipefitter should place it flush with the pipe and centered by eye. Then the flange is leveled by holding a carpenter's level even with the bottom edge of the top two holes. When it is leveled and centered, it is lightly tack welded at the top. The flange is leveled again and tack welded. Gaskets for flanges are laid out in the same way as flanges. Once the bolt holes are located and scribed, the gasket is cut out with shears or a knife.

OTHER PIPEFITTING TASKS

Once a pipefitter is able to fabricate offsets, flanges, tees, turns and elbows, and the different types of plugs, there are more difficult processes to be learned. These harder pipefitting tasks include such jobs as establishing grades, setting pipehangers and running pipehangers. When pipe is laid above ground, as in



PIPEHANGER

buildings or between buildings, it needs some sort of support. Without supporting frames, a pipeline would collapse of its own weight after only a short distance. For this reason, pipehangers are installed along with piping systems. The first step in installing pipehangers is to locate and mark their exact positions. Then the inserts are nailed to the *decking*. Nuts are placed in the inserts. Bolts are screwed into the nuts. Finally a splitting pipehanger is attached to the bolt. Once the pipehanger is attached, the nut and bolt should be screwed down. The pipehanger is then ready to receive the pipe.

Often a piping system will not be set exactly flat; rather it will be set at some grade, running up or down a slope. In such a situation, a line is stretched from the starting point to the end of a pipeline, or a section of pipeline, at the desired angle to the ground or to the ceiling. Pipe is then hung along this line in much the same way that brick is laid to a line. Sometimes a *surveyor's transit* is used to set up the path for pipe.

Pipefitters install extremely heavy equipment such as boilers, central heaters, air conditioning systems, radiators and the like. Thus, it is useful for pipefitters to be able to move heavy objects. There are several ways to do this. Steel rails are often used to slide heavy equipment up and down slopes. When pipefitters install heavy equipment, the floor is checked for ability to support the weight of the equipment. Then the rails are set up to move the equipment from one level to another. If the equipment is extremely heavy, the rails will often be supported by temporary concrete ramps. If ramps are not built, the equipment may have to be "cribbed"—that is, tilted and lowered onto the next level. Rails are also used to slide equipment along a flat surface. Rails are smooth and reduce surface area for the bottom of the equipment to touch. Because there is so much less surface area, there is less friction resistance between the rails and the bottom of the equipment. To reduce resistance even further, rails are greased.

The pipefitter should be able to hang heating and cooling coils. The first thing done is to install the mounting sockets in the ceiling. Then the three attaching rods are fitted into the sockets. Once the rods are in place, the *trapeze* is put in place. Then the coil is lifted up and inserted into place. Finally, the trapeze is leveled and squared up with the rest of the building.

Once equipment is in place, it has to be hooked up and checked for proper operation. Although the exact procedures of the hookup will vary from system to system, the steps taken in hooking up hot water heating coils, steam or steam coils will serve as an example of the process. A branch line is run from the main water supply. Appropriate valves are installed, as in any other pipe

fitting and are hooked onto this line. The pipefitter checks the headers and the thermometer connections. The stopcocks, 3-way valves and automatic valves of the system are installed last. Finally, the specs are checked against the actual installation one last time, and it is turned on. This, then, reviews some of the jobs performed by a pipefitter.

GLOSSARY
PLUMBING AND PIPEFITTING

Air gap—vertical distance between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture or other device and the flood-level rim of the receptacle.

Area drain—a receptacle designed to collect surface or rain water from an open area.

Backflow—the flow of water or other liquids into distribution pipes of a potable supply of water from any source other than the intended source.

Backflow connection—any condition whereby backflow can occur.

Backflow preventer—a device for preventing backflow.

Bending card—scale drawing of pipes that are to be bent showing the correct bends, points of tangency, etc.

Branch—any part of a piping system other than a main, riser or stack.

Branch vent—a vent connecting one or more individual vents with a vent stack or stack vent.

British thermal unit (BTU)—the heat required to raise one pound of water 1° Fahrenheit.

Building drain—the part of the lowest piping of a drainage system which receives the discharge from drainage pipes inside a building and conveys it to the building sewer beginning 3 feet outside the building wall.

Building sewer—that part of the horizontal piping of a drainage system which extends from the end of the building drain and receives the discharge.

Building storm drain—a building drain used for conveying rain water, surface water, ground water, subsurface water, condensate, cooling water or any similar discharge to a building storm sewer or a combined building sewer.

Building storm sewer—the extension from the building storm drain to the public storm sewer, combined sewer or other point of disposal.

Building subdrain—that portion of a drainage system which cannot drain by gravity into the building sewer.

Building trap—a mechanism installed in the building drain to prevent circulation of air between the drainage system of the building and the building sewer.

Calorie—the average quantity of heat required to raise the temperature of one gram of water 1° C.

Circuit vent—a branch vent that serves two or more traps and extends from in front of the last fixture connection of a horizontal branch to the vent stack.

Coefficient of expansion—a number that expresses the amount of expansion a material will undergo within a prescribed heat range.

Combination fixture—a fixture combining one sink and tray or a two or three-compartment sink.

Common vent—a vent connection at the junction of two fixture drains serving as a vent for both fixtures.

Continuous vent—a vertical vent connection at the junction of two fixture drains which serves as a vent for both fixtures.

Continuous waste—a drain from two or three fixtures connected to a single trap.

Corrosion—an electrochemical reaction that destroys or alters a metal by combining it with oxygen or another chemical.

Cross-connection—a connection between two separate piping systems, one of which contains potable water and the other, water of unknown or questionable safety. Water may flow from one system to the other, the direction of flow depending on the pressure difference between the two systems.

Developed length—the length along the center line of a pipe and its fittings.

Diameter—the nominal, commercially-designated diameter.

Double offset—two changes of direction installed in succession or series in continuous pipe.

Drain—any pipe which carries waste water in a building drainage system.

Ductility—the physical property of a material to elongate to a certain capacity.

Durham system—soil or waste systems in which all piping is of threaded pipe, tubing or other rigid construction using recessed drainage fittings to correspond to the type of piping.

Elastic limit—the limit to which a material may be stressed before it becomes permanently deformed.

Erosion—the gradual wearing away of a material by the constant action of abrasive materials upon its surface.

Fixture branch—a pipe connecting several fixtures.

Fixture drain—a drain from the trap of a fixture to the junction of that drain with any other drain pipe.

Fixture supply—a water-supply pipe connecting the fixture with the fixture branch.

Flood-level rim—the top edge of a receptacle from which water overflows.

Flush valves—devices located at the bottom of a tank in order to flush commodes and similar fixtures.

Flushometer valve—a device which discharges a predetermined amount of water to fixtures for flushing purposes.

Grade—the slope or fall of a line of pipe.

Hard water—water that contains calcium and magnesium bicarbonate in considerable quantities.

Horizontal branch—a drain pipe extending laterally from a soil or waste stack or building drain which receives the discharge from one or more fixture drains and conducts it to the soil or waste stack or to the building drain.

Indirect waste pipe—a pipe that does not connect directly to the drainage system but conveys liquid wastes into a plumbing fixture or receptacle which is directly connected to the drainage system.

Individual vent—a pipe installed to vent a fixture trap.

Interceptor—a device designed and installed so as to separate and retain hazardous or undesirable matter from normal wastes and permit normal sewage or liquid wastes to discharge into the disposal terminal by gravity.

Leader—the water conductor from the roof to the building storm drain, combined building sewer or other means of disposal.

Liquid waste—the discharge from any fixture or appliance in connection with a plumbing system which does not receive fecal matter.

Local ventilating pipe—a pipe on the fixture side of the trap through which vapor or foul air is removed from a room or fixture.

Loop vent—same as a circuit vent except that it loops back and connects with a stack vent instead of a vent stack.

Main—the principal artery of the venting system to which branches may be connected.

Offset—a combination of elbows or bends which brings one section of pipe out of line but into a line parallel with another section.

pH—the scale of acidity or alkalinity of a solution.

Plumbing fixtures—installed devices which are supplied with water or which receive or discharge liquids or liquid-borne wastes.

Potable water—water which is safe for drinking.

Process line—a pipeline that carries materials to the point of manufacture.

Public sewer—a common sewer directly controlled by public authority.

Relief vent—a vent which provides circulation of air between drainage and vent systems.

Return offset—a double offset installed so as to return the pipe to its original alignment.

Revent pipe—that part of a vent pipeline which connects directly with an individual waste or group of wastes, underneath or back of the fixture, and extends either to the main or branch vent pipe.

Rim—an unobstructed open edge of a fixture.

Riser—a water-supply pipe which extends vertically one full story or more to convey water to branches or fixtures.

Sanitary sewer—a pipe which carries sewage and excludes storm, surface and ground water.

Saturated steam—steam which is in contact with the water from which it was generated and which carries free moisture particles in suspension.

Septic tank—a watertight receptacle which receives the discharge of a drainage system and separates solids from liquids, digests organic matter through a period of detention and permits the liquids to discharge into the soil outside of the tank through a system of open-joint or perforated piping.

Sewage—any liquid waste containing animal or vegetable matter in suspension or solution.

Socket fitting—the process of joining two pipes by installing a fitting on one pipe that will receive the other pipe and completing the connection with a fillet weld.

Soil pipe—any pipe which conveys the discharge of water closets, urinals or fixtures having similar functions to the building drain or building sewer.

Stack—the vertical main of a system of soil, waste or vent piping.

Stack vent—a stack vent (sometimes called "waste vent") is the extension of a soil or waste stack above the highest horizontal drain connected to the stack.

Storm sewer—a sewer used for conveying liquid wastes other than sewage and industrial waste.

Strain—the deformation or change of shape in a body due to stress.

Stress—a force developed within a body when an external force is applied to it.

Subsoil drain—a drain which receives only subsurface or seepage water and conveys it to a place of disposal.

Sump—a tank or pit which receives sewage or liquid waste and is located below the normal grade of the gravity system.

Super heated steam—steam generated at a higher temperature than is possible at normal atmospheric pressure.

Supports—support hangers and anchors are devices for supporting and securing pipe and fixtures to walls, ceilings, floors or structural members.

Trap—a fitting or device constructed to provide a liquid seal which will prevent the back passage of air without materially affecting the flow of sewage or waste water through it.

Trap seal—the maximum vertical depth of liquid that a trap will retain, measured between the crown seal and the top of the dip of the trap.

Tuberculation—deposits of tubercles on the rough inner surface of piping. It is caused by a bacteria and may eventually cause the inside diameter of the pipe to be drastically reduced.

Turbulence—a condition which exists when the parallel flow with a pipe is misdirected by rough inner portions of the pipe.

Velocity—the expression of time rate of motion, usually expressed in feet per seconds.

Vent stack—a vertical pipe installed primarily for the purpose of providing circulation of air to and from the drainage system.

Vent system—pipe or pipes which provides a flow of air to or from a drainage system, or provides circulation of air within such a system to protect trap seals from siphonage and back pressure.

Waste pipe—a pipe which conveys only liquid waste, free of fecal matter.

Water distributing pipe—a pipe which conveys water from the water-service pipe to the plumbing fixtures and other water outlets.

Water main—a water-supply pipe for public or community use.

Water-service pipe—the pipe from the water main or other water source to the building served.

APPENDIX
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American Supply Association
221 North LaSalle Street
Chicago, Illinois 60601

International Association of Plumbing and Mechanical Officials
5032 Alhambra Avenue
Los Angeles, California 90032

National Association of Plumbing Heating-Cooling Contractors
1016 Twentieth Street, N.W.
Washington, D.C. 20036

National Supply Distributors Association
37 Lansdowne Street
Boston, Massachusetts 02215

Plumbing-Heating-Cooling Information Bureau
35 East Wacker Drive
Chicago, Illinois 60601

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American Pipe Fittings Association
26 Sixth Street
Stamford, Connecticut 06905

Distribution Contractors Association
531 Harvard Tower
4815 S. Harvard
Tulsa, Oklahoma 74135

Industrial Relations Council for the Plumbing and Pipe Fitting Industry
228 North LaSalle Street
Chicago, Illinois 60601

National Association of Pipe Nipple Manufacturers
P. O. Box 380
Merrick, New York 11566

Pipe Line Contractors Association
2800 Republic National Bank Building
Dallas, Texas 75201

United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the U.S. and Canada
901 Massachusetts Avenue, N.W.
Washington, D. C. 20001

AIR CONDITIONING AND REFRIGERATION

INTRODUCTION

Air conditioning and refrigeration workers install and maintain air conditioning and refrigeration systems. Although domestic installation activities are fairly simple, commercial systems require more complex processes. Installations will usually entail: (1) the moving, positioning and assembling of large refrigeration components; (2) the connecting of mechanical and electrical components of the equipment and readying of refrigeration components (purging lines, charging systems, etc.); and (3) the performance of operational checks on the installed equipment.

Air conditioning workers find the bulk of their jobs in the areas of domestic and commercial air conditioning, (automotive air conditioning is usually handled by automotive specialists; the same holds true for other transportation air conditioning). All three basic types of cooling equipment are to be found in these installations. By far the biggest consumer of refrigeration equipment is the food industries, although dehumidifying and

certain industrial processes require refrigeration systems. Hospitality and entertainment industries consume large amounts of worker service time. Health industries also use fair amounts of refrigeration equipment, although most is small volume equipment. Scientific research comprises an even smaller market, considering that most of their applications are installed and serviced by the consumer.

Air conditioning, refrigeration and heating work is highly skilled, complex and varied. No single worker would ever be expected to perform all of the listed activities. A large number of air conditioning and refrigeration mechanics are employed by the businesses that manufacture the equipment and are trained in the servicing of the equipment.

Air conditioning and refrigeration mechanics might at one time or another be expected to: Move heavy equipment, position it and install it; use cribbing method; roller method; rail or rail and ramp method; use coffin hoists. *Note*: Careful alignment, balancing, truing, etc. is usually done by a millwright.

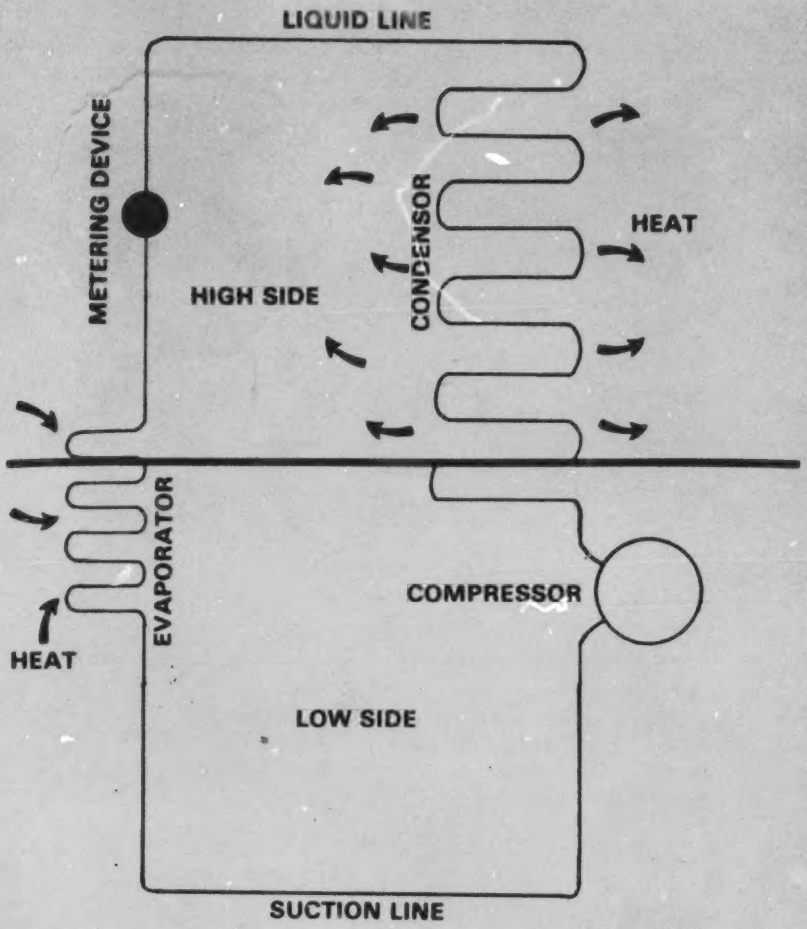
There are literally dozens of methods by which materials may be reduced in temperature. Egyptians disassembled rooms at night, carried stones off to cool damp places and returned them in the morning for purposes of keeping the palaces cool. Water has been stored in clay and cloth containers for centuries. The permeability of these containers allows evaporation to cool their contents. Water evaporation produces a cooling effect that has been long known, and certain areas of the world have flooded the roofs of houses, hung damp cloths in the path of prevailing winds and used other techniques to take advantage of the cooling thus obtained.

The present technological century has seen a great growth and sophistication in cooling systems. There are many systems, however, only two major types are being used on a large scale today. These are compression and absorption systems. All others combined, probably account for less than either one of these. Let's look at the most popular of these systems first, the compression systems.

COMPRESSION REFRIGERATION

Compression systems take advantage of the oldest known cooling technique—the absorption of heat by evaporating liquid. An evaporating liquid forms a gas. A compression cooling system reverses the evaporation process. It compresses the gas in a confined area, forming a liquid as the absorbed heat is released,

COMPRESSION REFRIGERATION



and then pumps the liquid to another area where it can evaporate. The evaporation removes heat from the materials to be cooled.

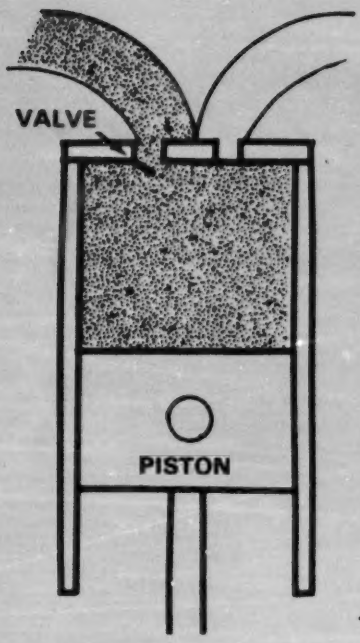
A special gas, called *refrigerant*, is enclosed in a system of pipes and machinery. A compressor squeezes the gas to a pressure higher than that of other areas of the system, and forces it into a coil of pipes called the *condensor*. Here the hot gases give up heat and condense into a liquid. The liquid is then pumped up, through a regulating device, and allowed to enter a more spacious area of tubing where the pressure is kept low. This area is termed the *evaporator*. In the evaporator, the liquid begins to boil, or evaporate because it is no longer under high pressure. In the process of evaporating, heat is removed from the evaporator and from the area around it. The cooled gases are then sucked into the compressor and recompressed where the cycle starts over again. All compression refrigeration, or air conditioning systems regardless of their complexity, are assembled in basically this way.

There are almost as many ways of compressing a gas as there are systems for cooling, but most may be grouped under three headings: (1) reciprocating cylinders (much like those in an internal combustion engine), (2) rotary compression, and (3) centrifugal compression. Each are used in a variety of ways, but let's look at the most basic and popular one.

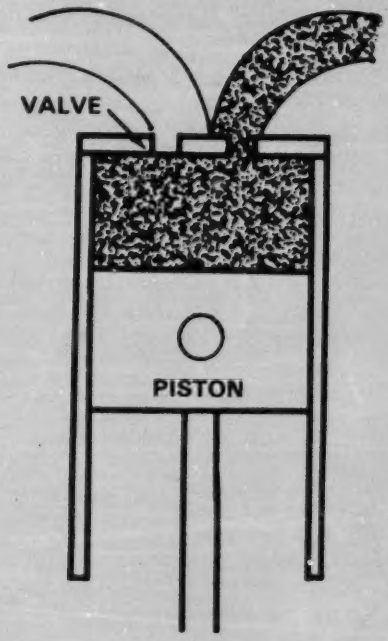
Reciprocating Compressor

The reciprocating compressor is comprised of a cylinder housing, a piston which is made to move up and down inside the cylinder walls, some sort of sealing system, valves, a crank to convert rotary motion to linear motion and a motor or other power source to drive the mechanism. As the crank rotates, the piston is drawn down, creating a vacuum inside the cylinder housing. The output valve remains closed, but the input valve opens as the gases from the evaporator try to fill the empty space. As the crank continues to rotate, the piston begins to move upward, and finally a pressure is created inside the space above the cylinder head. This causes the intake valve to close and forces the output valve open. The piston continues to move upwards, forcing the gases out of the cylinder and into the condensor. Both valves may be regulated to control the pressures at which they open.

There are, as we have said, many variations of this system. Some compressors use two or more cylinders. Some combine many cylinders with a "wobble plate" which converts the rotary motion into linear strokes. Some use the pressure differences created on both sides of the cylinder for various functions. Some require external lubrication, some rely on lubrication dissolved in the refrigerants, etc.



RECIPROCATING
COMPRESSOR



Rotary Compressor

A second type of compression system is the rotary compressor. This type of compressor has a circular space and an eccentric rotating element. The "piston" is so arranged that it rolls around in the space provided. This system, too, uses intake-output valves and fixed or stationary blades to separate the "compartments". As the piston rolls around in the space, it pushes gases ahead of it and out the output valve. But unlike the reciprocating type of compressor, it simultaneously pulls gases in through the intake valve. The wiper blade keeps the two compartments separated. Like the reciprocating compressor, the rotary compressor has many variations, but most of these may be classified as fixed or movable blade compressors, depending on whether the blade is set in the walls of the compression chamber or fixed on the sides of the rotor. Rotary compressors are widely used in domestic refrigerators, while reciprocating compressors find wide applications in domestic air conditioning units.

Centrifugal Compressors

Finally, the refrigerant gases may be compressed in centrifugal compressors. These compressors work by trapping gases in a spiraling vortex and spinning them, at very high speeds. This spin forces the gases outwards where they are allowed to exit through the output system. These compressors, though quiet and simple, work well only at very high speeds, and efficiently only at very high volumes. Therefore, they are used almost exclusively in very large air conditioning and refrigeration systems.

REFRIGERATION CONTROL

If these were the only variations possible in refrigeration systems, the life of an air conditioning and refrigeration worker would be vastly simplified. But, such is not the case. In most applications, it is desirable to control the temperature of the cooled area. Various methods have been developed to control temperatures, and, as a result, different refrigeration systems have been developed.

One of the first problems of refrigeration control is that of controlling the rate at which the refrigerant is introduced into the evaporator. If the rate is too low, little, if any, cooling will occur. If, on the other hand, the rate is too high, the evaporator coils will become flooded, cooling will be poor, and the low side lines ("suction lines") will frost over. If the condition is severe, liquid will enter the compressor and could damage or ruin it. It is necessary to introduce the refrigerant at such a rate that all of it evaporates in the evaporator. One of the simplest techniques for doing this is known as the *capillary tube*. It is called a capillary

tube because the tubing used is extremely small, and rather like the tubing used in other capillary action dependent systems.

Capillary Tube

Oddly enough, why the capillary tube operates as it does is not clearly known. What it does though, is well understood. The capillary tube is a length of extremely small tubing. Liquid under pressure is forced into one end and the other end is attached to the evaporator. Apparently, the tube offers resistance to the flow of fluids. The fluids perform work as they are forced through the tubing and thus they lose energy. The energy loss is reflected as a loss in pressure. Ultimately, the pressure becomes so low in the tube, that the refrigerant starts to boil. This condition is known as *vapor lock* and was a common gasoline line problem in early automobiles. The vapor lock condition further lowers the pressure and temperature in the last part of the tube, and the refrigerant enters the evaporator at evaporator pressure and temperature.

Capillary tube systems are combined with a temperature sensing element called a *thermostat* located in the cooling area. When the desired temperature has been reached, the compressor is turned off. The high pressure liquid, however, continues to bleed through the capillary tube until the pressures on both sides of the system are equal.

The capillary system has several advantages over other systems. First, it is simple, and hence economical. Second, since the pressures on both sides of the system equalize during the OFF cycle, the compressor starts the ON cycle with very little load. The ability to start a motor with a low load, therefore, represents an additional economy. However, since the timing of the cooling operation is not precise, temperatures vary inside the cooling space from 2° to 5°. Use of the system is, therefore, limited to small applications such as domestic refrigerators, freezers and air conditioners. Systems capacity is also low, so commercial uses are limited.

Automatic Expansion Valve

As mentioned before, capillary systems continue to cool for some time after the compressor has been turned off. The lag causes difficulties in controlling the cooling space temperatures. To get around this problem, early designers employed an automatic expansion valve (AEV) between the high line, which feeds refrigerant into the evaporator system, and the evaporator. This valve was so designed that it permitted the flow of refrigerant only when a sufficient vacuum had been created by the compressor in the evaporator. Thus, when the compressor was shut off by the

thermostat, pressure rose in the evaporator. The AEV shut off the flow of refrigerant, thus stopping the cooling process. The system was used on more expensive older model domestic refrigerators, and is still used in many small commercial applications. However, if the load is small and the valve set too close, this type of system may cycle on and off too often for economy. Also, the cooling rate is constant during the ON cycle, regardless of the needed load. In addition, pressure in the refrigerant and suction lines does not equalize, so a motor must be used which will start under a high load.

Thermostatic Expansion Valve

Many refrigerating uses require that the system operate under variable loads; hence, it would be desirable to control their cooling rate. To meet this need, the thermostatic expansion valve (TEV) was developed. This type of valve senses both pressure on the evaporator side of the valve and temperature. In addition, its output is variable. To operate, there must be a low pressure in the evaporator and the control bulb must be warmer than the desired temperature, before the valve will open. If the evaporator coil is quite warm, the TEV valve will open wide (when the compressor is ON) and the system will cool rapidly. As the evaporator becomes cooler, the TEV valve closes down and the cooling rate is lowered. Thus, if the cooling area temperature and load are constant and near the desired temperature, the cooling rate will be kept slow. In this way, ON-OFF cycle rates do not become unacceptably short. Likewise, if the system is used, say, in a large walk-in freezer and the door is left open for a while, the cooling rate will increase and the food will be better protected.

Both AEV and TEV systems offer closely regulated temperatures in the cooling compartment. However, there are several disadvantages. Both types achieve this end at the expense of requiring motors capable of starting under high loads since pressures in the system do not equalize during the OFF cycle. Also, valve adjustment for both types is fairly critical. Misadjustments result in severe losses of cooling efficiency and consequent increases in operating costs. Too, calibrating these valves is often a tedious task. Another disadvantage is that both operate with relatively "dry" evaporators—that is, the refrigerant is largely vaporized at its entrance point to the evaporator. All heat transfer, therefore, must take place between a metal wall and a gas. Transfers to gases are inherently inefficient. It would be far more efficient to allow the evaporating liquid to remain in contact with the evaporator walls. Two such systems offer this advantage.

Low Side Float System

The low side float system offers good temperature control combined with high operating efficiency. In this type of system, the liquified refrigerant is pumped to an evaporator which consists, basically, of a receiving tank and float valve construction, and a series of heat transfer coils. In operation, the refrigerant fills the coils and the tank to a pre-determined level. At this level, a needle valve attached to a float shuts off the flow of water (the operation is roughly similar to the operation of the float valve in most toilets). Operation of the compressor is usually controlled by a spring loaded switch on the low pressure side. When the float valve seals off the evaporator, evaporator pressure will drop. At a predetermined level, the switch turns the compressor off. Since the evaporating temperature of the refrigerant remains relatively constant over the range of pressures encountered in the evaporator, the temperature produced at the evaporator is also constant. However, as mentioned earlier, heat transfer is far more efficient since it is occurring between the walls of the evaporator and the liquid refrigerant.

Like the TEV and AEV systems, a refrigerant charge is collected in the receiver end of the condenser; however, in this system, a liquid charge is also collected in the evaporator. It can be seen, therefore, that this type of system (also known as a flooded system because of the "wet" condition of the evaporator) requires a rather large refrigeration charge. Also, like the other systems, compressor motors used in the low side float system must be capable of starting under heavy loads as the pressures do not equalize during the OFF cycle. However, the constant temperatures possible, combined with the high operating efficiency achieved in this type of system, make it ideal for applications in chilled drinking water fountains. Simplicity of design contributes to this system's compactness, and it is quite simple to service.

High Side Float System

There is one other type of flooded compression system. In this system, the control is also a float mechanism, but it is located in the receiver tank at the end of the condenser. It is called the high side float system.

In operation, the compressor compresses refrigerant which collects in the high side float receiver. When a sufficient amount of liquid refrigerant has been collected, the float lifts, and opens the valve allowing liquid refrigerant to be pumped to the evaporator. Usually, some sort of pressure control valve (a weight valve) is connected between the high side line and the evaporator to keep the pressure low in the evaporator. However, the valve

may be replaced with a capillary tube. Either way, low pressure liquid refrigerant is introduced into the evaporator where it trickles down by gravity action, evaporates and absorbs heat. Evaporation is rapid and heat transfer is quite efficient. The refrigeration cycle is controlled by a temperature or pressure sensitive device. Temperature control is not as good as in the low side float mechanism, but cooling is more rapid and more efficient; therefore, this system is used where very high operating efficiencies are desired. Aside from the fact that refrigerant charges must be very accurately measured, this type of system is quite easy to service.

ABSORPTION REFRIGERATION

Virtually all compression systems of refrigeration have one thing in common — they use electricity to power electric motors which, in turn, drive the compressors. In many circumstances, however, there are better ways of approaching the problem. These approaches are usually dictated by the relative availability and costs of various energy sources. For instance, in many rural areas electricity is not readily available. In some areas of the country, electricity is prohibitively expensive. It is in such areas that absorption systems find their greatest applications.

All absorption systems, no matter how complex, depend on a few basic working principles. *One*, certain gases are easily absorbed in certain liquids; conversely, they can be driven off by applying heat to the liquid. (Soda pop uses carbonated water, "soda" as its base. This water is made by bubbling carbon dioxide, a gas, under pressure, through cool water. The water absorbs the gas. The solution is then put in a bottle and capped to keep the pressure high. When the cap is removed, the pressure is relieved and the carbon dioxide bubbles out of solution. The bubbling is slow if the

drink is cold; fast if the drink is warm.) *Two*, as we learned in compression refrigeration, most gases may be condensed into liquids if cooled and put under pressure. This process releases heat. The same liquid, if put in a vacuum, will "boil" or evaporate rapidly and absorb heat in the process. The *third* operating principle of the absorption system is known as *Dalton's law of partial pressures*. Dalton's law is as follows: The total pressure of a mixture of gases equals the sum of the separate pressures exerted by each gas if it occupied the same volume as the mixture at the same temperature. What this means, simply, is that if you pump up your automobile tire to 32 psi pressure, then that pressure is really the sum of the pressures of the nitrogen, oxygen, carbon dioxide and other gases contained in the air. In other words, the nitrogen pressure might be 20 psi, the oxygen might be 10 psi and the carbon dioxide plus others would be at 2 psi. Each gas in the tire acts as if it were the only gas in the tire. That is, with respect to carbon dioxide, the pressure in the tire is 2 psi.

Simple Gas Absorption System

Gas absorption systems are fairly complicated, but there was one, made by Montgomery Ward in the earliest days of refrigeration, that can help in understanding how they work.

This system was called the "icy ball" and was intended for use at picnics. In use, the liquid filled side (called the generator) of the assembly was put in the campfire—the other ball, called the evaporator, was put in a bucket of water. The generator was filled with a mixture of water and gaseous ammonia. The heat from the fire caused the ammonia to be driven out of solution (like heat causes soda pop to bubble and foam rapidly). The pressure in the container rose rapidly, and the ammonia filled the entire assembly. But when the ammonia came into contact with the cool walls of the evaporator, it condensed into a liquid.

After a certain amount of time, the generator was taken out of the campfire and placed into the bucket of water. The absorber side of the assembly was then put into an insulated box with the beverages and whatever else the picnickers wanted to keep cool. As soon as the generator was put into the cool water, the steam generated during the time the generator was in the fire began to condense and a vacuum developed inside the assembly. Immediately, the ammonia in the evaporator began to evaporate and to be *absorbed* in the water in the generator. The evaporation caused the evaporator to become cold. Whenever the ammonia was gone, the camper would repeat the process.

Applications For Gas Absorption Systems

Even today, this intermittent cycle refrigerator is used in rural areas where electricity and piped gas are not readily available. The refrigerator uses kerosene burners in the generator which must be filled with a measured amount of kerosene every morning and lit. When the kerosene runs out, the burners go out and refrigeration begins. There are other systems, too, which use solids rather than liquids to absorb the refrigerant when [illegible] and to release the refrigerant under application of heat. In [illegible] chael Faraday first discovered the refrigerating effect of am[illegible] while experimenting with silver chloride, a substance which [illegible] an absorb a great deal of ammonia under certain conditions. Solid absorption systems still find limited applications in industry.

Despite this, it might seem that if absorption systems could only be operated intermittently, and their rates of cooling were not controlled, they would have little use in industry. In fact, there are a number of systems that operate continuously. These systems use all the principles of refrigeration previously discussed, but they usually include Dalton's law of partial pressures.

The process begins at the generator, which is basically a small boiler filled with water and ammonia in solution. The boiler is constructed like an electric coffee percolator. Heat from the flame drives ammonia out of solution in large bubbles. The bubbles are trapped in the small tube going to the separator, and as they rise, they carry the ammonia and some water up the tube. In the separator, the water is allowed to fall back to the bottom. A pipe at the bottom of the separator allows the water to flow downwards to the absorber.

Since the ammonia gas is hot, it rises in the tube until it arrives at the condenser. The condenser works just like the condenser in a regular compression refrigeration system. Here the gases are cooled, and they condense into a liquid. The liquid ammonia condenses and flows by gravity action, down to the top part of the gas heat exchanger. The exchanger is made so that the liquid ammonia cannot fall back into the absorber, but must instead continue to flow into the evaporator. It's in the evaporator that the system uses Dalton's law.

The evaporator, gas heat exchanger, and the absorber are filled with hydrogen under a pressure of about 200 psi. When the ammonia enters the evaporator, it attempts to duplicate the pressure being produced by the hydrogen, since, as we learned from Dalton's law, each gas acts as if it were the only gas present. As the ammonia boils away, heat is absorbed from the evaporator walls and hence, from the cooling area. It now only remains to get

the ammonia back to the generator. This is accomplished in the gas heat exchanger.

The cooled ammonia vapor, mixed with hydrogen, begins to collect at the top of the gas heat exchanger. It settles (since it is cool) and flows downward through the exchanger and into the absorber. The water in the absorber is warmer than the water in the generator. The ammonia is absorbed by the water, but hydrogen is not soluble in water. The slight pressure formed by this action forces the lighter hydrogen out of the absorber by way of the outside jacket of the gas heat exchanger, where it enters the lower side of the evaporator. The hydrogen gives up some of its heat to the ammonia so that it does not enter the evaporator at too high a temperature. This flow also helps keep the cool ammonia at the top of the evaporator so that it will better settle through the exchanger.

Finally, as the percolator action in the generator removes water, (water, now again saturated with ammonia), it flows into the generator from the absorber there to be percolated and to begin the process again. Once started, the cycle is continuous.

Advantages Of Gas Absorption Systems

This continuous cycle absorption refrigeration system has found wide application in domestic refrigeration units, although it is also widely used in air conditioning applications for both homes and industry. The system offers several advantages over mechanical refrigeration systems. Absorption refrigeration offers good savings on operating costs, because the heat energy of the fuel is used directly to produce the cooling effect. In other systems, the energy is converted into mechanical energy, which is then converted into "refrigeration power". Gas absorption refrigeration is, therefore, more efficient. Also, absorption refrigeration is inherently reliable. The refrigerating mechanism itself requires no moving parts at all, so there is nothing to wear out. Even in large systems, only small pumps may be required to move fluids from one area to another. So, this type of system not only saves on fuel, but on maintenance as well.

Disadvantages Of Gas Absorption Systems

Absorption systems are not, however, without drawbacks. For one thing, they are quite expensive. The plumbing is very complicated in a continuous cycle gas absorption machine. Not only is the plumbing complicated, but it must be of good quality since operating pressures in the system are quite high, and since the refrigerant in most units is noxious ammonia. Also, absorption systems do not start up well, "recover" well, or for that matter,

operate well if the evaporator temperature is high. Such conditions are not conducive to good refrigerant flow. Gas refrigerators that have just been defrosted, been left open or have been inoperative for long periods of time, will take a long time to cool off. On the other hand, absorption systems *keep* things cold very economically and are quite economical for cold storage.

Flues and condenser surfaces must be kept clean on domestic absorption machines so that heat transfer is as efficient as possible. Dust and dirt on radiating surfaces reduce heat transfer and will markedly reduce the effectiveness of the unit. Large, commercial units are usually water cooled and, therefore, do not suffer this problem.

There are, of course, many variations of this process. Some large units, for instance, use water as the refrigerant and various types of chemicals, such as lithium chloride, as the absorber. Generators may be heated by gas, electricity, liquid fuels or steam. A variety of heat exchangers may be employed in the various cycles to optimize temperatures of various cycle elements. Larger or more sophisticated units may employ mechanical assistance in various areas, or have even more elaborate schemes such as automatic defrost features or cycled temperature control.

MISCELLANEOUS REFRIGERATION SYSTEMS

There are numerous other systems in use in the refrigeration industry. For instance, trucking firms, in order to cool foods during shipment, spray the interiors of refrigerated trucks with liquid nitrogen. No attempt is made to recycle the refrigerant, so this type of refrigeration is one of the *expendable refrigerant systems*.

Miners and other industrial workers who work in high temperature environments, often wear suits cooled by *vortex tube coolers*. In these devices, high pressure air is injected sideways into a tube, closed at one end, where it expands and begins spinning around at high speed. There is a compression effect at the outer edge of the tube, and a relative vacuum develops at the center. A smaller tube is connected to the closed end, at the center where the pressure is low. The air swirling at the outside becomes warm as it leaves the large tube. The air at the center becomes cool and flows out the small tube. The cool air is then usually distributed via smaller tubes to various points throughout the worker's suit where it helps him keep cool.

Thermo-electric refrigeration is accomplished by a semiconductor device which converts electricity directly into heat on one side and into cold on the other. It is useful only for very small applications.

Various systems may be compounded together to achieve lower temperatures. That is to say, one refrigeration machine may be used to cool the condenser of another which operates at a much lower temperature. Such systems are used extensively in *cryogenics industries*. Cryogenics industries study or utilize the unique properties of temperatures several hundred degrees below zero. At these temperatures, some materials become perfect conductors of electricity. If, for instance, an electrical impulse is injected into a super-conducting ring, it will continue to go around in circles forever. Some of the latest computers use super-conducting memory banks to store and retrieve information from their frozen memory banks. Since super-conductors have zero resistance to electricity, they can be used to carry incredible amounts of power, with very little line loss. Already, studies are underway to determine the feasibility of building a super-conducting power line. Even with the expense of running elaborate refrigeration systems underground, and spaced as close as every 1/2 mile, some engineers feel that less electricity would be spent or lost than is lost when electricity is transmitted over conventional high lines. Super-cooled magnets of incredible strength have been developed which may one day aid the discovery of new energy sources. Clearly, these compound systems, called *cascade refrigeration systems*, will come to be used more and more in the future.

STEAM JET REFRIGERATION SYSTEM

One other unusual system is used fairly extensively. This is the steam jet refrigeration system. This system uses a high pressure steam injected into a specially shaped cavity. As the steam rushes to escape, it creates a partial vacuum in the cavity which is connected to an evaporator. With this type of steam, the evaporator is constructed like a water tower, with spray nozzles at the top and a series of baffles to disturb the downward flow of the water. A circulating pump forces water through the cooling coils and into the spray heads in the evaporator. In the vacuum of the evaporator, water, which is used as the refrigerant, boils at very low temperature. The boiling, or rapid evaporation, chills the water which is then used for cooling elsewhere.

This system requires expensive equipment to generate large amounts of steam. Therefore, uses for this type of system are usually limited to very large units (units 100 tons and over). As one might expect, the steam jet refrigeration system is popular in New York where steam is available as a utility. It is frequently used to cool the condensers of large absorption units, which are in turn used for cooling quenching baths and other specialized industrial processes. Minimum cooling temperatures are limited,

however, to around 40°. Lower temperatures can cause the refrigerant to freeze.

Another system uses steam energy more efficiently. It uses steam itself as the refrigerant. In this system, high pressure steam is injected into the back of a cavity shaped very much like that of a rocket engine. The rapidly expanding steam loses temperature readily, and this slight cooling is collected by a circulating water jacket. The cooled water, however, is pumped directly to the throat of the "engine," where the steam begins to be recompressed, and therefore, to heat rapidly. If the velocity of the steam at the throat is carefully adjusted so that it coincides with the speed of sound, two things happen. One, adiabatic expansion of the gases leaving the engine causes a dramatic reduction in temperature. Second, a sonic boom is generated. Generating this boom requires work, which requires energy. The energy loss is further reflected as a loss in temperature. The gases leaving the nozzle of this engine are quite cold, and may be used for refrigeration. This type of system operates very efficiently. However, it also creates a constant sonic boom. System applications are limited to areas where the noise may be controlled or suppressed (or where it does not present too great a problem) and to establishments which have a large supply of high pressure steam available. For these reasons, this type of system has realized little use.

GLOSSARY

AIR CONDITIONING AND REFRIGERATION

Absolute humidity—the amount of humidity in a given volume of air.

Absolute pressure—the amount of gauge pressure plus 14.7 pounds per square inch.

Absolute zero temperature—the temperature at which all molecular action ceases (-275C and -460F).

Accumulator—a tank which receives excess liquid refrigerant from the evaporator and prevents it from entering the compressor.

Agitator—a device used to move confined fluid in a system.

Air coil—a coil which is sometimes used in heat pumps as an evaporator or condenser.

Air-conditioner—a device which cleans and circulates air within a certain area and controls temperature and humidity.

Alternating current (*AC*)—an electrical current that reverses or alternates its direction at regularly recessing intervals.

Ambient temperature—temperature of air or fluid which surrounds an object.

Ammeter—an electrical instrument or meter used to calibrate and measure amperes.

Ampere—a unit of electrical current that is equivalent to the flow of one coulomb per second.

Armature—the revolving parts of an electro-magnetic device.

Automatic expansion valve (*AEV*)—a pressure valve which reduces liquid refrigerant from high pressure to low pressure.

Baffle—a plate, wall, screen or vane used to deflect or direct the flow of air or fluid.

Bearing—a machine part that supports or aligns a pen or other moving part.

Bimetal strip—a temperature-indicating apparatus which operates on the theory that when two pieces of dissimilar metal are welded together they will bend when the temperature changes.

Boiling temperature—the temperature at which a given liquid is changed into a gas.

Bonnet—the part of a furnace casing which forms a plenum chamber from which supply ducts receive warm air.

Boyle's law—with the temperature constant, the volume of a gas will vary as the pressure varies.

Brazing—a process of joining metal by using a non-ferrous file rod. The base metals are not fused together.

British Thermal Unit (BTU)—the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near 39.2 degrees Fahrenheit.

Calorie—the amount of heat required at a pressure of one atmosphere to raise the temperature of one gram of water one degree Centigrade.

Capacitor—a device that stores electrical energy and is used for starting or running circuits on electrical motors.

Capacitor-start motor—an electric motor which uses a capacitor in the starting circuit.

Capillary tube—a device used to restrict the flow of refrigerant so that the high side and low side pressure are properly maintained while the compressor is running.

Centimeter—metric measuring unit which equals .3937 inches.

Charles' law—the volume of a gas at a constant pressure will vary according to temperature.

Circuit breaker—a safety device that will open an electrical circuit when it becomes over-loaded.

Closed circuit—a circuit in which electrons are traveling.

Compression—a process of increasing pressure by using mechanical energy.

Compressor—a pump in an air-condition system which draws a vacuum or low pressure on the cooling side of the refrigerant cycle and squeezes the gas into the high pressure side of the cycle.

Compressor, hermetic—a compressor that has the drive motor sealed in the same housing that contains the compressor.

Compressor, open-type—a compressor that has a crankshaft extending through the crankcase which an outside motor drives.

Compressor, reciprocating—a compressor that uses a piston and cylinder to provide pumping action.

Compressor, rotary—a compressor that utilizes eccentric machinery, vanes, or other revolving mechanisms to create pumping action.

Condensation—liquid which is formed when a gas is cooled below its dew point.

Condenser—the refrigeration device which gets high pressure, hot refrigerant gas from a compressor and cools the gas until it turns to a liquid.

Condenser fan—a mechanism used to force air through an air-cooled condenser.

Condensing unit—the refrigeration part which pumps the vapor-like refrigerant from the evaporator, compresses it, turns it into a liquid in the condenser, and returns the liquid to the refrigerant control.

Conduction—the transfer of heat from a warmer to a cooler particle by direct contact.

Contaminant—a substance such as dirt or moisture which may accumulate in the refrigerant or refrigerant oil in an air-conditioning system.

Control—the manual or automatic device used to start, regulate, and stop the flow of gas, electricity or liquid.

Convection—transfer of heat by a gas or liquid.

Convector—a surface which is designed to release heat by the process of convection.

Cooling tower—a tower that cools water by evaporation of water in air.

Cycle—a group of events which are often repeated in the same order; one period of an alternating electric current.

Damper—a valve or plate which is installed in the cold and warm air ductwork and is used to regulate the amount of air flowing through the duct.

Dehumidifier—a device which removes moisture from the air in an enclosed space such as a room.

Dew point—the temperature at which vapor turns into liquid (at 100 percent humidity).

Double heat transfer—the transfer of heat from the plant to the heated medium and from the medium to the air in the conditioned space.

Epoxy—a synthetic adhesive made of plastic.

Evaporative condenser—apparatus which uses open spray or spill water to cool the condenser.

Evaporators—the part of an air conditioning system where refrigerant vaporizes and absorbs heat.

Evaporator coil—a part of the evaporator which evaporates refrigerant. It is made of coils of tubing.

Fahrenheit scale—a scale for temperature measurement which places the freezing point of water at +32 degrees and the boiling point of water at +212 degrees at standard atmospheric pressure.

Farad—the unit of capacitance equal to the capacitance of a capacitor with the potential of one volt when it is charged by one coulomb of electricity.

Flame test for leaks—a method of testing for refrigerant leaks by using a torch.

Flare—flares are made by a special tool which, when properly used, forms a 45 degree angle on the end of tubing.

Flare nut—a fitting used with a flare which makes a connection with another flare fitting.

Flue—an enclosed passage in a chimney which carries exhaust smoke and fumes to the outer air.

Flux brazing, soldering—a substance applied to metal in order to facilitate a good brazing joint.

Furnace—that part of a warm air heating system in which combustion takes place.

Fuse—a safety apparatus in an electrical circuit which breaks when overloaded.

Gauge manifold—a device which is designed to hold compound and high pressure gauges and is equipped with valves for control purposes.

Ground wire—the connection of an electrical current with the earth through a conductor.

Halide torch—a torch-like device used to detect halogen refrigerant leaks.

Heat, latent—heat which changes the form of a substance without changing its temperature.

Heat pump—a compression cycle system which distributes heat to a space. It can also remove heat from the same space.

Heat, sensible—heat which changes the temperature of a substance without changing its form.

Heat transmission coefficient—any of a number of coefficients used in calculating heat transmission through different materials and structures.

H. G. mercury—a metallic element that is a heavy silver white liquid at room temperature.

High side—the parts of an air-conditioning system which are under high pressure.

Humidity—moisture; the degree of dampness in the air.

Induction motor—the most common type of single phase motor. It operates on the principle of a rotating magnetic field.

Low side—the parts of an air conditioning system which are under low pressure.

Microfarad—a unit of condensed electricity equal to one millionth of a farad.

Motor, capacitor—a single-phase induction motor which has a starting winding connected to a capacitor for better starting.

Motor control—an apparatus used to stop, start or reverse a motor. It operates at certain predetermined temperatures or pressures.

Non-ferrous—any metal or metal alloy which does not contain iron.

Orifice—an opening which is the correct size to control fluid flow.

Overload—a device which stops the operation of a unit when operating conditions become dangerous.

Pinch-off tool—a tool used to pinch tubing walls together to stop all fluid flow.

Purging—releasing a compressed gas through a system for the purpose of removing contaminates.

R.11: Trichloromonofluoromethane—a low pressure refrigerant.

R.12: Dichlorodifluoromethane—a refrigerant known as "Freon 12".

R.22: Monochlorodifluoromethane—a synthetic refrigerant.

Radiation—using heat rays to transfer heat.

Refrigerant—a substance used in air-conditioning systems to absorb heat in the evaporator by changing from a liquid to a gas, and for releasing heat in the condenser by changing from a gas to a liquid.

Refrigeration oil—a specially refined oil which is free from moisture and other contaminants and is used in air-conditioning systems.

Saturation—a condition which exists when no more can be absorbed or retained.

Service manifold—an apparatus equipped with valves and gauges, used for servicing air-conditioning systems.

Short circuit—a condition which results when one part of a circuit touches another part and causes the current to take the wrong path.

Short cycling—an air-conditioning system which starts and stops more than it should.

Sight glass—a glass window which shows the amount of refrigerant, oil or bubbles in the system.

Silica gel—a chemical compound which is used to absorb moisture from a refrigerant.

Silver brazing—a brazing process which uses a filler rod that contains about 45 percent silver.

Soldering—using a relatively low temperature (less than 800 degrees Fahrenheit) to melt an adhesive (the solder) and join two pieces of metal together.

Starting winding—the winding in an electrical motor used only for starting the motor.

Suction line—the tubing in an air-conditioning system which carries the refrigerant from the evaporator to the compressor.

Superheat—to raise the temperature of a liquid above the boiling point.

Test light—a light with two leads used to test a circuit and determine if it is in line.

Thermal insulation—a material used to resist the flow of heat from one space to another. Usually used between walls or partitions.

Thermocouple—two unlike metals fastened together which generate electricity when heated.

Thermostatic expansion valve—a valve located in the evaporator coil which operates by temperature and pressure to control the flow of refrigerant.

Three-phase—a combination of three AC currents varying in phase by 1/3 of a cycle.

Vacuum—a state in which pressure is below atmospheric pressure.

Vacuum pump—a special compressor used to create vacuums.

Vapor—a substance in a gaseous state that, under ordinary circumstances, is a liquid or a solid. In this context, it usually refers to a vaporized refrigerant.

Voltage—a term used to denote electric potential or potential difference expressed in volts.

APPENDIX

AIR CONDITIONING AND REFRIGERATION

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ADDITIONAL SOURCES OF INFORMATION

Air Conditioning and Refrigeration Contractors of America
20 North Wacker Drive, Suite 2232
Chicago, Illinois 60606

Air Conditioning Refrigeration Institute
1815 N. Fort Meyer Drive
Arlington, Virginia 22209

American Gas Association, Inc.
1551 Wilson Blvd.
Arlington, Virginia 22209

Hydronics Institute
35 Russo Place
Berkeley Heights, New Jersey 07922

Mechanical Contractors Association of America
5530 Wisconsin Ave. N. W. Suite 750
Washington, D.C. 22015

National Oil Fuel Institute
60 East 42nd Street
New York, New York 10017

Plumbing-Heating-Cooling Information Bureau
35 East Wacker Drive
Chicago, Illinois 60601

MILLWRIGHTING

INTRODUCTION

Millwrights move, install and maintain milling machines, automatic assembly equipment and many other types of industrial equipment. They need to know about complex machinery so that they can dismantle, align, repair and reassemble it. There are two kinds of millwrights. One is called a *construction millwright*; the other is a *maintenance millwright*.

Construction millwrights fit bearings, align gears and wheels, attach motors and connect belts. In order to move machinery they use hoists, cranes, jacks, crowbars and wood blocking. When they are disassembling or assembling equipment, their tools include wrenches, screwdrivers and hammers. When they align equipment, they use micrometers, calipers, squares and plumb bobs. Often, construction millwrights work for companies which specialize in moving and installing industrial machinery on a contract basis. Many others work for manufacturers who hire millwrights to install their products in customers' plants. These millwrights usually specialize in putting in the types of equipment which their employer manufactures.

Maintenance millwrights keep a wide variety of machinery and equipment in working order. When equipment breaks down, maintenance mechanics determine the cause of trouble and repair the machinery. In finding the cause of the trouble, the millwright disassembles the machinery partially or completely. Once the machine has been taken apart it is then reassembled.

In addition to repairing machinery when it breaks down, maintenance mechanics work to keep machinery from breaking down. To do this they inspect the machines, grease them, clean and repair the parts, and, in some places, keep maintenance records. Maintenance millwrights work on different types of equipment, depending on the type their employer owns and on the type of industry in which they work. For instance, a maintenance millwright who works in the garment industry might specialize in repairing industrial sewing machines. Those working for printing and publishing companies would specialize in maintaining and repairing printing presses and other printing machinery. Some of the tasks which maintenance millwrights must be familiar include reading blueprints or lubrication charts. Often, they use catalogues to order replacements for broken or worn out parts. On occasion, millwrights may draw a design for a part which will be fabricated by a machine shop.

Maintenance and construction millwrights frequently do each other's jobs. Thus, their skills are very similar. Because their jobs and their skills are so similar, they will be considered together.

There are about six major industries for which millwrights work. The petrol-chemical industry probably employs more millwrights than any other industry. Millwrights in this industry set up the pumps, turbines, engines, gears, motors, fans and blowers used in refining petroleum. The steel industry uses huge rollers, presses and conveyor systems which may be designed to carry as much as 40 tons of steel. All these rollers, presses and conveyor systems are installed by millwrights. The paper industry hires millwrights also. There are many conveyor belts in a paper mill all of which are installed by millwrights. In the electric power industry the major equipment used is mainly the turbine and the generator. This equipment is installed and maintained by millwrights. In the steel industry, equipment is often huge—some turbine generators are 120 feet long. Many millwrights work in the automobile industry. In any auto plant there are thousands and thousands of miles of conveyor systems. All of these conveyors are installed and maintained by millwrights. Millwrights also work on ships. They install and maintain the ship's engines and pumps.

Whatever the industry in which a millwright works, there are seven basic areas of knowledge with which to be familiar. These are: Layout and measurement, machines for fabricating parts, bearings, shaft alignment, pumps, lubrication and power transmission systems.

LAYOUT AND MEASUREMENT

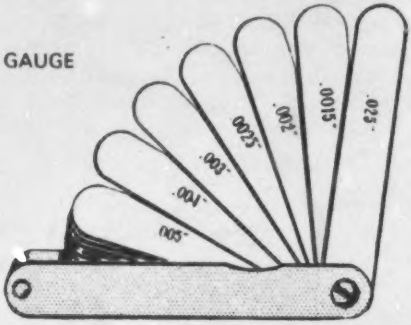
A millwright must be able to make precision layouts and measurements. There are many gauges and measuring tools for

this purpose. These tools include cylinder gauges, thread gauges, squares and an entire family of micrometers. Some of the micrometers used include calipers, inside, depth and pitch micrometers. In addition, there is an entire family of vernier instruments, among which are calipers, bevel protractors and vernier height gauges. Further, millwrights do a variety of precise measurements with gauge blocks, telescoping gauges and sine bars. Levels are taken with dial indicators, optical flats and precision levels. It is easy to see that millwrights are involved with a great deal of measurement and must be able to use a variety of precise measuring instruments.

INSTRUMENTS USED

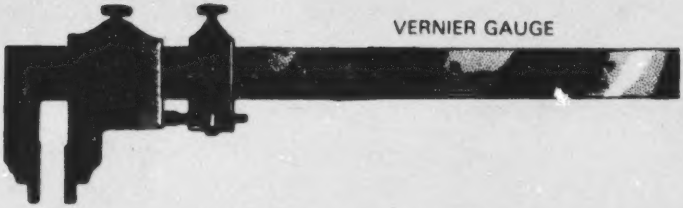
Straightedges are straight lengths of wood or metal which the millwright uses to check a surface for straightness. A *square* is usually a hardened steel blade attached to a beam. A *cylinder gauge* is used to measure the trueness of a cylinder and the smoothness of its inner walls. *Thread gauges, center gauges* and *feeler gauges* are also commonly used types of gauges. Thread

FEELER GAUGE



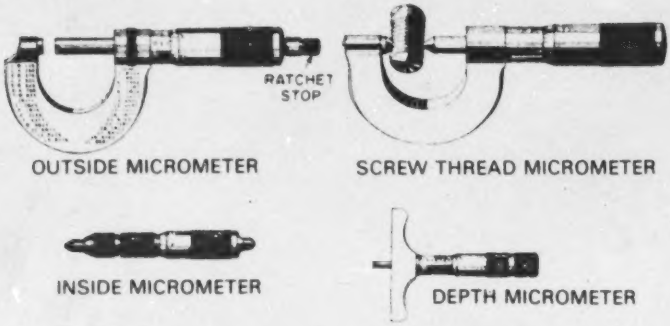
gauges are used to measure the threads cut in screws and worm gears. Center gauges are used to check lathe centers. Feeler gauges are inserted like knife blades in between two closely touching surfaces, in order to measure the distance between them.

Vernier gauges are an entirely different sort of measuring instrument. They are used where an extremely precise sort of measurement is needed. There are a number of different vernier measurement devices, depending on the kind of surface the millwright needs to measure. The vernier caliper and the vernier height gauge are the two most important gauges used. Vernier calipers may be used to measure both inside and outside surfaces. Vernier height gauges are used to measure vertical heights. The



major advantage of vernier gauges is that they allow very small distances (down to 1/1000 of an inch) to be measured accurately. Bevel protractors can be used to measure angles to a fine accuracy — in fact, down to 0°12′. This is useful for measuring angles precisely and accurately.

Another sort of device which provides extreme accuracy in measurements is the *micrometer*. There are several types of micrometers for different measuring purposes. Outside micrometers measure distances between outside surfaces. Screw thread micrometers measure the diameter of screws between thread bottoms. Inside micrometers measure the length of inner surfaces. Depth micrometers are used for insertion into holes to measure their depth. Micrometers should always be kept clean and well-oiled.



Millwrights must also level their work. Usually they use precision levels to do this, because work must be done with exactness. The allowance for error in fitting parts together is called *"tolerance"* and usually is measured in a few thousandths of an inch.

There are a variety of basic steps in layout which are used in almost any machine shop operation. Layout is the process of marking out on a metal surface the design to be machined. Usually layout should be made to within 1/64 inch. The tools mainly used in making layouts are the combination square, the machinist's square, the surface gauge, the scribe, the straight-

edge, the ruler and the caliper. These instruments all ensure that straight and curved lines are drawn accurately and exactly.

The basic operations are: Laying out parallel lines, laying out lines at angles, and laying out curved lines and circles. Parallel lines and lines at angles are usually laid out by using two combination squares. Circular and irregular lines are laid out from a center point with dividers. The center point is prick punched to hold the point of the dividers in place. These layout lines, by the way, are actually drawn onto metal with a *scriber*. A scriber is a hard, sharply-pointed metal pick-like instrument which can be used to scrape very fine lines onto metal surfaces.

MACHINES FOR FABRICATING PARTS

Once the layout process is done, there are several machine processes which millwrights use to make repairs. One used is the *drill press*. The drill press is used to drill holes in a piece of metal. Holes are usually drilled with a twist drill. As its name would suggest, it resembles a piece of steel which has been twisted. All twist drills have three major parts. These parts are: The *shank*, the *body*, and the *point*. The shank is the part of the drill which is held in the drilling machine. The body of the drill is that part which is twisted and which forms the cutting edge of the drill. The point of the drill is pushed into the material to be cut.

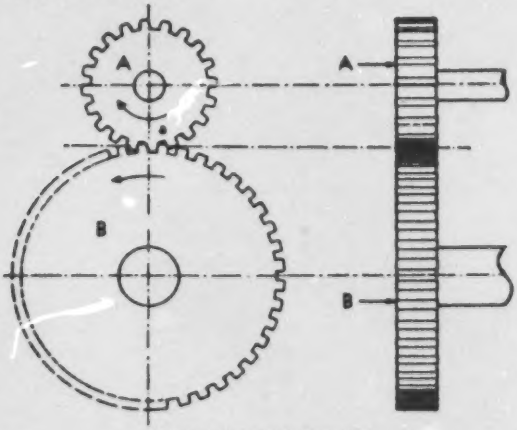
To use the drill press with skill, a millwright needs to have some knowledge of speeds and feeds on the press. The *cutting speed* of a drill press is expressed in feet-per-minute or fpm. Millwrights figure the cutting speed of a drill by multiplying the circumference of the drill by the revolutions-per-minute (rpm), which is the speed of the press, and dividing the result by 12. The *feed* of a drill is the rate at which the drill penetrates the work at each revolution. Feed is measured in thousandths-of-an-inch-per-revolution.

In any drilling operation, there are several things which the millwright can do to make the drilling more accurate. The material to be drilled should be clamped down with vises. Before starting the operation, debris should be wiped off the table of the drill press. The object to be drilled should be center punched at the point where it will be drilled. The spindle is brought down to the punched center. Where large holes are to be drilled, a center drill is used to drill a hole so that the larger drill will center in it. On most metals a cutting oil should be used to cut down on the friction and heat caused by drilling these metals.

The *latne* is another machine millwrights use frequently. There are several different types of lathes, but all of them have certain basic parts. The major parts are: The bed, headstock, tailstock, carriage,

apron, feed rod, lead screw, gearing and the compound rest. The *bed* is the base, the foundation of the lathe. The other parts of the lathe are mounted on the bed. The most noticeable feature of the bed are the ways. The *ways* are the rails on which the carriage and tailstock can slide. The *headstock* contains the belts and gears which drive the lathe. Headstocks are either fitted with belt and pulley or with gearing mechanisms. The *tailstock* is used to hold a center for work being machined on centers. It has two parts. The base is attached to the ways. The top can be moved back and forth on its base. The *carriage* carries the compound rest, which is the device that supports the cutting tool. It also has slots for holding work which may be bored. The *apron* is attached to the carriage. This mechanism controls carriage movement on longitudinal feed and thread cutting. *Longitudinal feed* is motion of cutting mechanisms on the lathe parallel to the ways. *Cross-feed* is the motion of the cutters perpendicular to the ways. The *feed rod* provides power to the longitudinal feed and cross feed apparatus. The feed rod is powered through a gear train.

Very often threads must be cut using a lathe. This is done with a lead screw. It has cutting threads which thread as it turns. It is driven by a gear train. *Gearing* is a way of raising or lowering the speed at which a shaft rotates. Two shafts are turned by having two gears mesh together. As each tooth on the driving gear meshes with a space between teeth on the other gear, each gear rotates a small amount. If each gear, say, has 20 teeth, both gears will complete one turn at the same time. If, however, one gear has 20 teeth and the other gear has 40 teeth, the one with 20 teeth will make a complete rotation while the gear with 40 teeth has made only half a rotation.



GEAR ARRANGEMENT

The last part of a lathe to be discussed is the *compound rest*. This is the place where the cutting tool is mounted. There are two parts to the compound rest. The first part is the swivel. The *swivel* can be adjusted to any angle and clamped in place. The *topslide* is placed on the swivel.

There are several basic lather operations. These are: Turning, cutting tapers and boring inside diameters. *Turning* is a way of taking off excess metal so that the diameter of the workpiece is reduced. Workpieces may be either rough-turned or smooth-turned. Rough-turning cuts away a large part of the diameter of the workpiece. Smooth-turning is a cut which takes off 1/32 inch or less of the diameter of the workpiece. When turning is not done between centers, the process is called straight-turning. When a workpiece is straight-turned it is mounted in an *independent chuck*. An independent chuck is somewhat like a vise, except that the chuck has three or four jaws while the vise has two. The four-jawed universal chuck is made so that jaws 1 and 3 and jaws 2 and 4 should be closed at the same time. Three-jawed universal chucks are made so that the jaws open and close at the same time. Despite the variety of chucks, all of them are designed to hold a workpiece in place while it is being turned.

Taper-turning is a cutting process in which the diameter of the workpiece is gradually lessened toward one end. To measure the amount of taper for any given length of work, subtract the diameter of the small end from the diameter of the large end. In straight-turning the finished workpiece has the same diameter throughout. Tapered-turns have a varying diameter. Millwrights turn varying diameters by either placing the cutting tool at an angle to the workpiece or by placing the workpiece at an angle to the cutting tool. There are three methods mainly used for cutting tapers. The first method is to adjust the tailstock so that it is off center. The amount to which it is placed off center determines the amount of taper produced. The length of the workpiece is important to consider in adjusting the tailstock, because the shorter the workpiece the greater the taper. The compound rest is often adjusted where a sharp taper is needed. The compound rest is adjusted to the angle which the taper is to make with the centerline. Then, too, there is a taper adjustment on lathes. This is used where long tapers are to be made and where two or more identical tapers are needed. The taper adjustment is simply placed at the angle at which a taper is needed.

The last major lathe job is *boring*. Boring is the process in which the lathe is used to machine holes and any other cylinder-shaped surface inside a block of metal. When work is bored it is usually held in a chuck. The boring tool looks very much like a turning tool. Lathes are used to bore interior cylindrical shapes.

BEARINGS

Millwrights work with a variety of bearings. Most of the machinery they are expected to repair contain many different types of bearings. Bearings are used to reduce friction between moving parts in machinery. There are several different types of bearings commonly used. *Ball bearings* are large steel balls which are mounted between two rotating rings to keep them apart. *Roller bearings* are small, smooth steel rods upon which two rings roll back and forth. There are *straight roller bearings* which contain smooth, straight steel rods. *Tapered roller bearings* have cone-shaped steel rollers. *Needle roller bearings* have small steel rollers. All bearings, though, have two steel rings between which are placed the steel balls or rollers. The rings are then free to turn in different directions or for one ring to turn while the other remains stationary.

Although bearings are used in a wide variety of machines and in many different places on equipment, there are two major ways in which they are installed. One of these methods is called the heat-expansion technique; the other is the press fitting technique. In the *heat expansion technique* the first step is to clean the *bearing seat*, the place where the *bearing housing* will be fitted. Then the millwright uses a micrometer to measure the dimensions of the bearing seat and the bearing housing. If the housing will fit, it should be placed in an oil pot or an oven and heated to a temperature between 200° and 250°F. Bearings should never be heated to a temperature above 250°. Further, bearings should not be heated for a long time at a temperature above 200°.

The other method is called *press fitting*. Usually this is done with a hydraulic press. The millwright first cleans the shafts and bearing housings. Then he oils the bearing seat. The bearing housing should be measured with a micrometer to ensure a snug fit. Then the hydraulic press should be adjusted so that the pressing pad applies pressure to the bearing evenly. As the millwright applies pressure to the bearing, the pressure gauge on the press is checked to make sure that excessive pressure is not applied. Generally, press fitting is done on relatively small bearings, while heat expansion is used on relatively large bearings.

SHAFT ALIGNMENT

Another task millwrights often perform is shaft alignment. *Shafts* are long, rigid metal bars which carry energy from one part of a machine to another. Shafts should be correctly aligned. If not, eventually the machinery will be damaged and will require repairs. Shafts are attached to a fly wheel or rotating rod by means of *dowel pins*. As the fly wheel turns, the shaft goes up and down.

The other end of the shaft is attached to another fly wheel or rotating rod with the same diameter as the first. As the driving wheel turns, the shaft goes up and down and the wheel that is driven turns. If, however, the shaft is badly attached to one of the wheels and does not go far enough, or goes too far, or vibrates, it is said to be "out of alignment". There are several things to remember in shaft alignment. All factory assembled units are factory aligned. Once these units are shipped the alignment may be upset. Shaft alignment should be done when stresses have been removed. All the support feet on the drive unit must be in the same plane. When one leg is slightly longer or shorter than the others, the situation is called *soft foot*. This is a condition which is difficult to remedy. Millwrights need to also keep in mind what is called *indicator bracket sag*. Indicator brackets are the couplings to which safts are attached on both the drive wheel and the wheel that is driven. If the indicator bracket is not rigidly attached, it will sag under the force of gravity. Such sag may cause misalignment of the shaft.

Shafts are usually aligned at factories cold. Yet, when machinery operates, it heats up. As it heats, it expands. If a "hot check" is not done and machinery checked while it is warm, it is possible that as the shaft and brackets expand with heat, they may lose their alignment. A "hot check" is a check of the shaft alignment at operating temperature.

There are three major methods of shaft alignment. These are the *two indicator method*, the *dynamic-to-static method*, and the *indicator-reverse method*. The *two indicator method* is used on small units. It is possible on such units to rotate both shafts at the same time. The feet of the unit are adjusted. The shaft and the indicators are connected. Then the alignment is made on top to bottom measurements with a steel rule and feeler gauge. Whatever shim changes need to be made are done. A final reading is taken, and then the unit is connected.

The *dynamic-to-static method* is used very seldom because it is for units in which both shafts cannot rotate as one. This method has problems because it is often inaccurate. Once again the process is to clean the pads. Then the millwright checks for soft foot. Adjustments are made for bracket sag. Finally, the needed shim changes are made and the unit is reconnected.

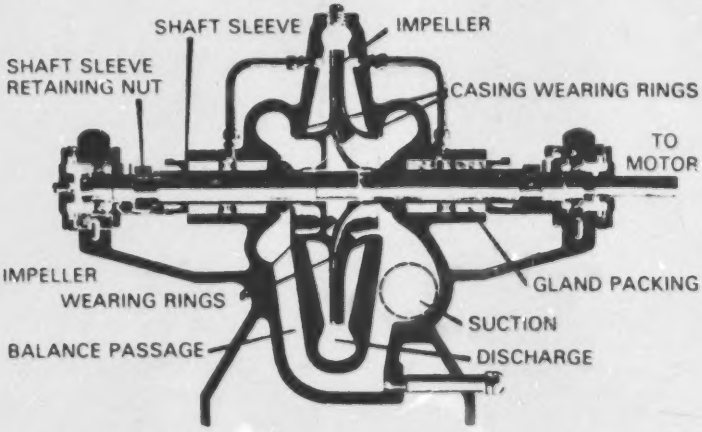
The *indicator-reverse method* is used with units which are large enough to require a lot of time in making a shim change. The indicator-reverse method requires as few shim changes as necessary. Basically, the indicator-reverse method takes driver to driven and driven to driver readings every 90°. These readings are plotted on graph paper. What shim changes are needed are made and the equipment is connected.

PUMPS

Millwrights make a wide variety of adjustments on pumps. The pumps which millwrights repair are centrifugal, rotary and reciprocating pumps, but centrifugal pumps are the ones most commonly used. The type of pump used depends on its application. There are dry pit pumps, sludge pumps, wet pit pumps, sump pumps, vertical turbine pumps, vertical propeller pumps, closed coupled pumps, in-line pumps and can pumps. Wet and dry pit pumps, sludge pumps and sump pumps all are names for pumps which are used to pump drainage water from different sorts of drainage pits. Dry pit pumps remove drainage water from an adjacent well. Wet pit pumps are immersed in the water being pumped. Both are varieties of sump pumps. Sump pumps are especially designed to handle drainage and sewage from buildings. Sludge pumps are heavy duty sump pumps designed to move thick liquids.

Centrifugal Pump

Let's look at a *centrifugal pump*. This pump raises the level of water by forcing a pool of water in a standpipe to rotate very rapidly. As the water rotates, it rises along the edge of its container by centrifugal force. As it rises, water overflows the edge of the container and runs into a pipe. As it flows, water from an underlying source flows in to take its place. All centrifugal pumps have an *impeller*, a small paddle-wheel device that rotates at a high speed to stir up the water and create the centrifugal force which will cause water to flow. The impeller is turned by a motor, usually electric, though it can be a gasoline or steam engine. The impeller is immersed in a pool of water and rotated.



There are three major types of centrifugal pumps. *Volute type pumps* are designed so that the impeller drives the water into an expanding spiral casing. *Diffuser pumps* have stationary guide vanes surrounding the impeller to change the direction in which the water flows. *Turbine pumps* have fanshaped devices which rotate. Each one of the many blades on the turbine gives a small thrust to the liquid as it rotates.

Any centrifugal pump, though, has basic parts. The impellers have been described. The *casings* house the impeller, and the pump motor *wearing rings* absorb the friction where the impeller meets the pump housing. *Anti-friction bearings* are used at many points in the pump. *Shaft sleeves* prevent the shaft of the impeller from corroding; *lantern rings* and *staffing boxes* prevent air from leaking into the casing. *Shaft seals* prevent air from leaking into the shaft.

A pump's output is measured in gallons-per-minute. The pressure at which liquid flows from a pump is measured in pounds-per-square-inch. Pump designers talk about "head" on a pump and "pump capacity". The *head* is the height of a column of liquid which is being pumped. Whenever a column of water is standing in a pipe, it exerts a certain pressure. The column which creates the pressure is called the head. The pressure on the bottom is measured in pounds-per-square-inch (p.s.i.). *Pump capacity* is the amount of liquid a pump can deliver in a given time. Usually this is measured in gallons-per-minute.

Pump Maintenance

One concept which millwrights work with in dealing with pumps is the *net positive suction head*. The net positive suction head, or NPSH, can create more pump problems than any other single factor. All liquids have a vapor pressure. When pressure on liquids falls below their vapor pressure, they flash or turn to a gas. A pump cannot pump steam or gas; so when the liquid vaporizes, the flow from the pump falls off. The pump is said to be *vapor bound*. The NPSH is the actual suction pressure of the pumping system after the friction resistance, or friction head and vapor pressure have been removed. If the pump millwright is not careful, the pumping system will have too much vapor pressure or too much frictional resistance to operate adequately.

In pumping systems there are several other areas which the millwright should watch closely. Pumps sometimes may run with discharge valves closed or clogged. On other occasions, pumps may run backwards or without priming. The millwright should always watch for pumps running without proper lubrication. Major repair jobs done on centrifugal pumps are relubrication, re-

packing the stuffing box and installing new impellers. Another job is pump priming. No centrifugal pump should be run until it has been filled with water. Very often pumps will need to be filled before they are turned on. In this case, the millwright has the job of priming the pump.

In overhauling a centrifugal pump there are several basic procedures to be followed. As soon as the pump is taken from its well, the millwright cleans the outside and inside of the pump casing. The *stuffing box* is taken out. The millwright takes the casing from the back plate and removes the *mechanical seal* and *packing gland*. The *outboard bearing shaft* and the *shaft assembly* go next. The millwright takes out the bearings and checks the shaft for run-out at the bearing seats and along the seal. The impeller needs to be checked for wear at the wear bands and at the impeller tips. If the bearings have rough spots, they should be replaced. Then the mechanical seal is checked for wear and for cracks. The bearing housing and the casing, likewise, are checked for cracks and worn spots. Then, if bearings need to be installed, they are put in. Finally, the pump is put back together and reinstalled.

Millwrights will have to install mechanical seals and expandable packing on centrifugal pumps. A *mechanical seal* is a device installed around the shaft to prevent leakage. The sealing surfaces are at right angles to the shaft and are made up of two polished lubricated parts running on each other. There are several steps in removing and replacing a seal. The process of taking the pump apart has been described. The rotating head is removed from the shaft and the gland insert is removed from the gland. A new insert is installed in the gland and a new rotating head is installed. Then the pump is reassembled and reinstalled.

Expendable packing is often used instead of a mechanical seal. Seals are easier to install and, in fact, are being used more and more often. Packing is useful where pumps work with liquids above 300°F. Often too, it is used on liquids which are volatile—that is, which evaporate easily. Packing material may be made from cotton, flax, viscose rayon, leather, asbestos, teflon, phenolic resins, silicone or rubber. The process of actually replacing packing is relatively simple. The pump is removed from its well and its packing gland is removed. Old packing is taken out. The stuffing box and lantern ring are cleaned. Once the stuffing box is measured, the packing is cut and soaked in oil. New packing rings are installed and the lantern ring is reinstalled. Last, the packing gland is tightened. Finally the entire pump is reassembled.

ROTARY AND RECIPROCATING PUMPS

Two other types of pumps that the millwright needs to know about are rotary and reciprocating pumps. Let's look at the *rotary pump* first. The difference between the rotary and the centrifugal pump is that the rotary pump scoops liquid up from a pool in the pump chamber while the centrifugal pump merely sets liquid to moving within a piping system. The rotary is mainly used to transmit power in hydraulic systems, that is, in systems which carry power from one place to another by placing pressure on an enclosed liquid at one place, and then having the liquid put pressure on something else at another point.

The Rotary Pump

There are three types of rotary pumps used: One uses gears to move the water; the second uses vanes as impellers; the third uses a piston as a way to move liquids. In the gear type pump, closely meshing gears push oil through their teeth as they turn. The oil is then forced through an outlet. In vane type pumps, a chamber is expanded so that a vacuum is created and more liquid flows in. Then the chamber is reduced in size and the excess liquid is forced out. In vane pumps, liquid flows into a chamber in which a rotor with vanes pushes it toward an exit. In piston type pumps, a series of pistons are moved reciprocally so that while one piston chamber is being emptied, another is being filled. Millwrights need to be able to disassemble and reassemble rotary pumps. There are several steps to be done. The millwright first removes the pump from its base. The outside casing of the pump is cleaned. Next the coupling is removed. Once inside the pump, the millwright removes the bearing plates and rotating elements. They are checked for wear and cleaned. These elements are then reinstalled and the pump is closed.

The Reciprocating Pump

The third major type is the *reciprocating pump*. A reciprocating pump's major parts have an up-and-down motion rather than a rotary or circular motion. The first part is a *piston* or plunger, which actually moves the liquid. The second part is an *inlet or intake/admission valve*, which takes liquid in. The third part is the *outlet or outflow valve*, through which water is discharged. There is a basic difference between pistons and plungers; a piston is shorter than the stroke of the cylinder while the plunger is longer than the stroke.

Reciprocating pumps are mainly used to pump water. There are two basic types of reciprocating pumps—lift pumps and force pumps. *Lift pumps* raise liquids from one level to another by

creating a partial vacuum in a cylinder. Atmospheric pressure then forces water into the cylinder. Lift pumps have two parts—an open cylinder and a bucket valve which is built into the piston. A lift pump must be primed; that is water must pour over the top of the cylinder to seal off air flow around the sides of the piston. There are two piston strokes (two parts of the cycle) in a lift pump. The downward stroke is used to draw water into the bucket valve, and the upward stroke discharges the water.

The *force pump* lifts and forces water against an outside force. This really means that it can lift water further than water will rise in a partial vacuum in a cylinder. There are two types of force pumps—single action and double-action. In a single action force pump there are two parts to the cycle. Water is drawn up into a cylinder. As the piston cycles downward, it forces the discharge valve to open and pushes water out. In a double-action pump, water is forced into one side of the cylinder, while flowing out the other side.

Maintenance of Reciprocating Pumps

Millwrights need to disassemble and reassemble reciprocating pumps. Although there is a variety of these pumps, ranging from those found in oil refineries to those which pump water for city water supplies, there are certain features which all these pumps have in common. In any repair operation, the first thing done is to shut off the power supply. Then the valve assembly cap, suction and discharge valves are removed. The valves are inspected for wear. The sliding valve is checked. The packing around the piston is removed and the shaft is cleaned. Finally, the pump is reassembled.

LUBRICATION

One of the major tasks of a millwright is lubricating and greasing machinery. This is particularly important to prevent wear on bearings that have been installed. The bearing cap is removed and the old grease is scraped away. The bearing is then repacked with grease and reinstalled. On other types of machinery oil is often used as a lubricant. Essentially, the millwright needs to check the amount of oil in the system and add more as needed. Lubricants used need certain qualities. They must not corrode the machinery. They need to be viscous, that is thick but not too thick. They need to reduce friction in the machinery to a minimum at a temperature at which the machinery operates.

When lubricating machinery, the millwright needs to know how the lubricating system actually operates. Although grease is applied directly to bearings, oil lubrication systems are often

complex. There are several different kinds of lubricating systems found in machinery. Some centralized lubrication systems have pumps which circulate the lubricant through the machinery; others have gravity feed devices. The simplest gravity feed is a *drip feed lubricator*. The lubricant flows from a single pool and drips onto the bearings to be oiled. Another device is a *wick feed* which is based on the tendency of liquids to flow up a strand of closely woven yarn. A similar device is the *wiper system* of lubrication in which a cup of oil is moved about and wipes oil onto a fiber which flows to a bearing. Still another system uses an oil mist sprayed onto each bearing. The mist, or spray, is created by forcing a thin stream of oil through a nozzle before it reaches the bearing.

POWER TRANSMISSION SYSTEMS

The last topic with which millwrights should be somewhat familiar is the variety of existing power transmission systems. All these systems are based on the fact that power is generated in one place—an electric motor, a steam turbine, a gasoline or diesel engine—but is used at another place in the form of machinery. Power transmission systems transfer energy from one point to another. There are two major ways in which energy is transferred. The first method is by a series of gears which mesh together; the second uses a roller chain. Gearing devices are used where the speed or direction of power flow needs to be changed. Roller chains are used where power needs to be carried over a relatively long distance. A device which works similarly to the chain, called a V-belt, is often used. V-belts are very similar to fan belts found on automobiles.

Gears are rather complex. A gear is made by cutting a series of equally spaced grooves around the outside of a wheel. There are a number of different gears and gearing devices in use today. Major gears include spur gears, helical gears, bevel gears and worm gears. Each of these has its own special use and applications.

GLOSSARY
MILLWRIGHTING

Acid steel—steel that is made in a furnace that is lined with materials that contain silicon.

Air-hardening—hardening that is done with certain types of steel by using air rather than water or oil.

Allowance—the difference in dimensions necessary for clearance between two mating parts.

Alloy—the combination of two or more metallic elements to produce one metal.

Aluminum oxide—an artificial abrasive used in the manufacturing of grinding wheels.

Angle iron—a structural member made of iron that forms a 90° angle with its sides.

Angle plate—a fixture used on the milling machine and drill press to which the work piece can be clamped to hold it at a right angle to the table.

Annealing—the process of heating carbon steels to a point just above their lower critical temperature and then allowing the metal to cool off at the same rate as the oven or furnace.

Anti-friction bearing—bearings which have an outer ring, an inner ring and the rolling elements (balls, rollers, needles) as their components.

Assembly drawing—a drawing which shows how components of an assembly fit with respect with one another. It is not designed to permit the making of any of the components.

Austenitic steels—steels which contain enough alloying elements, such as nickel and chromium, to permit the formation of austenite at room temperature.

Babbitt—a bearing metal composed of 4 parts copper, 12 parts tin and 8 parts antimony. It has a melting point of about 460 degrees.

Backlash—the lost motion between gears that is necessary to permit free running of the gears without binding them.

Balance, dynamic—the distribution of weight around the centerline of a part while it is turning in a balancing machine. This is the most accurate type of balancing when the part is rather long compared to the diameter.

Balance, static—the distribution of weight around the centerline of a part while it is placed in balancing ways. The heavy side will sink to the bottom.

Balancing ways—two sets of knife edge rollers with almost frictionless bearings upon which the part is placed to be static balanced.

Ball bearing—an antifriction bearing which uses spherical balls as the rolling elements.

Base line—a term used in blueprint reading and layout work to refer a set of dimensions to one given line.

Bearing—any support to be used to support a sliding or rotating member.

Belt clamp—clamps placed on each end of a flat belt to provide the drawing power necessary to bring the belt ends together. The clamps that are used to secure the ends of the belts to each other become part of the belt itself.

Belt dressing—mixtures of substances that are applied to a "V" belt to increase the gripping power of the belt and to add pliability to the belt.

Belt, link—a chain that is made of many links that pivot on pins or rollers. It is used to transmit power.

Belt, "V"—an endless belt of a cross section that has tapered sides which fit into the groove of a sheave. The tapered sides create a wedging action.

Bessemer steel—a steel which has undergone the reduction process by blowing air up through the molten metal. The oxygen in the air unites or reduces the carbon content in the molten iron.

Between centers—measurements that are taken from one center to another center. Also used in machine tool operation to denote turning stock that is mounted between two centers in the lathe.

Bill of material—a listing of the various materials that go into the making of a given product, showing the number of pieces and type of material.

Blind hole—a hole that does not go all the way through.

Blueprint—a systematic method of placing ideas and thoughts on paper permitting someone other than the originator to make a part or product.

Bluing—a process of coating a surface with a substance to permit one of two operations to be performed. 1) For layout work, the substance dries to permit scribe lines to become vivid. 2) For plain bearing work, the substance does not dry and permits the contact area between two mating parts to be shown.

Bore—the inside diameter of a coupling, bearing, etc., through which a shaft must fit.

Boss—the raised portion of one mating part which fits into the recess of another mating part to locate the two parts in reference with one another.

Brinell hardness number—a number that is given to a material to show the relative hardness of that material. Brinell is the name of the machine that does the testing of the hardness.

Broach—the name of a tool that removes metal from the inside of a hole to a given geometric configuration—square, triangular, octagonal, etc. Used to cut keyways inside a bore.

Bushing—a sleeve that is placed inside a hole in order to reduce the inside diameter of the hole or to place a different metal inside the hole.

Caliper—a tool used to measure the inside or outside of a part. It is a transfer measuring tool.

Caliper, micrometer—a tool used to measure distances or measurements to an accuracy of .0001". It is a direct measurement tool.

Cam—a metal disc that is any form but circular, that changes rotary motion to reciprocating motion.

Carbide—a compound of carbon with metal to form hard materials used in the making of cutting tools, drills, lathe tools, saw, etc.

Carburize—the addition of carbon to a metal for the purpose of hardening the metal.

Case hardening—the process of hardening just the outer surface of steel while keeping the interior relatively soft for ductility.

Cast iron—hard and brittle steels that contain from 2% to 6% of carbon. While the metal is in the molten state, it is poured into molds to obtain various shapes. The addition of silicon permits the metal to flow very readily.

Cast steel—steel that has been molded, rather than rolled, into the desired shape.

Center punch—a tool used to provide an indention in preparation for the use of a twist drill.

Chamfer—to remove the sharp edge of two planes joining at right angles.

Chasing threads—1) the cleaning up of threads that already exist by using a die nut, 2) the making of external threads on an engine lathe.

Chevron packing—rings of pliable packing used to break down pressure. The cross section of the rings appear much like the chevrons used to denote military rank.

Clearance—the difference in the dimensions of two mating parts which permits the parts to move freely relative to one another.

Coefficient of expansion—the amount a given material will expand or contract per degree of temperature change per inch of material.

Couplings—a machined part that fastens two shafts end to end for the purpose of transmitting rotary motion.

Crank throw—the distance from the center of the main journal to the center of the crank pin.

Critical speed—the speed at which a balanced rotating body will vibrate due to its rigidity and mass.

Crocus cloth—an abrasive cloth with an iron oxide coating used to polish metals.

Dial indicator—an instrument with a movable stem which, when moved a given amount, will indicate that amount on the face of the instrument. (Usually in .001" increments).

Diameter—the longest straight line that can be drawn across a circle.

Die, nut—a tool used to chase or repair threads.

Die, threading—a tool used to cut external threads on a rod.

Dowel pin—a straight or tapered pin used to locate two mating parts and also used to make reassembly more accurate.

Draw-filing—the process of removing metal from a part by holding the file flat at right angles to the workpiece and pulling and pushing the file back and forth.

Drawings, mechanical—a blueprint which is usually drawn to some scale that permits that particular part to be made in the shop.

Drill—the process of using a twist drill to remove material and make a hole. Not as accurate as reaming.

Eccentric—not having the same centers, as in the throw of a crank shaft.

Expanded metal—sheet metal which has had slits cut into it and is pulled apart to form a mesh.

Expansion fit—a fit where there is an interference in the dimensions, but clearance necessary for the assembly is provided

by expanding the outer member using heat. Upon cooling, the outer member contracts, thereby gripping the inner member.

Extrusion—the process of forcing materials through a set of dies to produce a cross section which is the same as the die. Plastics are best extruded to produce the proper shape.

Feed—the amount a tool progresses with respect to each revolution of the workpiece.

Feet per minute—used to describe the speed of belts and materials being machined in a lathe.

Fit, interference—a fit in which there is no clearance between the mating parts.

Fit, running—a fit which has clearance between the outside diameter of a shaft and the inside diameter of a bearing or bushing. The amount is dependent upon the size and the material.

Flame cutting—the process of cutting metals with the use of an oxygen/acetylene flame.

Flywheel—a wheel that is attached to the end of a crankshaft. It is used to store energy from the power stroke to be used to turn the crank during the exhaust stroke.

Forge—the process of shaping hot metal by a series of hammer blows, or the dropping of a die onto the metal.

Foundation—the base on which a machine sets. It is usually massive to absorb the running vibrations of the machine. Can be of either steel or concrete.

Gauge—an instrument that is used to determine the size of a part or a dimension within that part. Also applicable to the system of sizing sheet metal and wire.

Galvanized steel—steel which has been dipped into a bath of molten zinc to prevent rusting.

Gasket—a pliable material placed between two mating parts to prevent leakage.

Gears—a set of wheels which have teeth cut into them that mesh with each other to ensure positive power transmission.

Gear, idler—an intermediate gear that serves to change direction or separate two other gears. Does not affect the gear ratio or speed.

Gears, diametral pitch—the size of the teeth on a gear. In order for two gears to mesh, the diametral pitch must be the same. Diametral pitch is independent of the gear size.

Gland—a sleeve or nut that goes around a shaft to hold the packing in place or hold one part of the mechanical seal.

Governor—a device on a machine that controls the speed of that machine. It can be either mechanical or hydraulic.

Grinding wheel—a wheel that is made of abrasive particles that have been bonded together. Its main function is to remove materials slowly and accurately.

Grinding wheel, dresser—a tool that is used to remove the dull abrasive particles or the glaze from the face of the wheel to permit faster cutting action.

Grout—the material used between a machine base and the foundation. It is usually a mixture of sand and cement or a chemical epoxy.

Hardening—a heat-treatment process whereby metal is changed from a soft, ductile state to a hard, brittle state for wearing properties.

Heat treatment—heating and cooling metal under controlled conditions to impart desired properties into the metal. The metal does not actually melt.

High speed steel—tool steel that will remain hard and sharp at high temperatures.

Hook, spanner wrench—a wrench that partially encircles the outside of a nut which has slots cut into it. The hook of the wrench engages into the slots of the nut to turn it. Most commonly used on shafts to secure bearings.

Hot rolled—metals that have been formed while still hot and pliable.

Housing, pump—that portion of a pump that contains the bearing and the lubricant.

Iron—an element which is the largest ingredient in steel.

Jack screw—a machine screw used to lift or separate two adjoining surfaces of a machine.

Jam nut—a second nut used to lock against a first nut to prevent it from vibrating loose. The jam nut is generally thinner than the first nut.

Journal—the section of a rotating shaft which rests in a bearing.

Key—a piece of steel, usually square or rectangular in cross section, which fits into a keyway of the bore and the keyseat of the shaft to prevent turning of the bore on the shaft.

Lantern ring—a ring that goes inside the stuffing box in between two rings of packing to allow cooling liquids to enter the packing.

Lap—to produce a flat smooth surface using an abrasive and a lapping block.

Layout—the process of drawing on a part to be machined to show what material must be removed and where.

Level—the use of a machinist level to position a machine horizontally.

Lift—the action of a pump to lift a liquid up to the pump from a lower level.

Light waves—the use of light to measure flatness of a lapped and polished surface. Electricity is passed through helium gas and the interference of the light wave is observed as the light passes through an optical flat.

Lubricant—any liquid that is placed between two mating, moving parts. This liquid replaces dry friction with liquid friction.

Magnaflux—a process used to inspect metal parts for cracks. An electrical charge is passed through the metal and fine magnetic particles are dusted over the part. The magnetic particles will collect at any cracks.

Mechanical seal—a pressure breakdown device that turns two extremely flat surfaces against one another.

Metal spraying—the process of spraying heated metallic particles onto a worn surface for building up that surface.

Mild steel—steels with an extremely low carbon content, easily welded.

Monochromatic light—the helium light source used to produce light waves for measuring flatness.

Multistage pump—a pump with two or more impellers that are arranged in series to produce a large head.

Needler bearing—an anti-friction bearing that has an outer race and needles for the rolling elements but generally uses the outside diameter of the shaft for the inner race.

Normalizing—a heat treatment operation used to improve the grain structure of a metal. It differs from annealing in that the metal is allowed to cool in the atmosphere.

Nozzle, steam—the part of a steam turbine that directs the flow of steam against the blades of a turbine wheel.

Oiler—a device used to supply oil to a bearing. Generally the oilers used for process equipment are of the gravity feed type.

Optical flat—a piece of fused quartz that has been accurately ground to extreme flatness. It is used in conjunction with

monochromatic light to measure flatness of lapped, polished surfaces.

Outboard bearing—the bearing farthest from the coupling. (Pump manufacturers call the outboard bearing the one closest to the coupling.)

Overhung pump—a pump whose impeller is supported by bearings on one side of the impeller only.

Packing—rings of expendable, pliable, fibrous materials used to reduce the amount of leakage between the shaft and the stuffing box of a pump. The packing can also be mechanical.

Peening—the process of stretching metal with a series of hammer blows. Used to relieve internal stresses caused by welding.

Pickle—the process of cleaning parts in an acid bath, especially newly constructed pipelines.

Pig iron—the iron which is removed from a blast furnace in the steel making process. It is the main ingredient for most steels.

Ping—the sound that an internal combustion engine makes when the spark is advanced too far or when the trouble is pre-ignition.

Piston pump—a pump which uses several pistons attached to a central hub.

Piston rings—rings which fit into grooves cut into the piston which prevent leakage of gas or liquids around the piston.

Piston speed—the feet per minute that a piston travels inside a cylinder.

Plain bearing—a bearing which uses no rolling elements to allow the shaft to turn. There is a sliding action instead of the rolling action in the anti-friction bearing. Most plain bearings are made of either babbitt or bronze.

Plumb bob—a pointed, heavy object, usually filled with mercury, which is suspended from a string to denote vertical alignment.

Plunger—a plunger is similar to a piston in purpose. The piston has rings around the piston head and the plunger has packing rings around the outside diameter. The plunger is capable of producing more pressure.

Preload bearings—before the bearing is placed into service, the bearing itself is preloaded by the use of shims so that when the bearing is loaded it will not deflect any further. The preload is placed on the races of the bearings.

Priming—the process of filling the casing of a centrifugal pump so that it will begin pumping when the pump is turned on.

Pump, centrifugal—a pump that uses centrifugal force to move liquid. The impeller actually slings the liquid out the discharge. No valves are used.

Pump, rotary—a pump that uses positive displacement action to move the liquid. The impeller can be of many types—gear, lobe, screw, sliding vane, etc. Valves are sometimes used.

Race—the outer and inner members of most anti-friction bearings in which the rolling elements roll. Often referred to as outer and inner rings.

Radial bearing—a bearing, either anti-friction or plain, that can absorb loads only in the radial direction, outward from the center of the shaft.

Reamer—a cutting tool that is used to produce an accurate and smooth hole.

Recess—the female portion of two mating parts. The section which the boss fits into.

Reciprocating pump—a positive displacement pump which uses valves and has a back and forth pumping action.

Retaining rings—commonly referred to as snag rings or keeper rings, they are rings which fit into a groove on the inside of a bore or the outside of a diameter.

Run-out—the total deviation for either a straight line or a perfect circle. This is measured with a dial indicator.

S. F. P. M.—surface feet per minute as applied to grinding wheels.

Safe working load—the load that a lifting device can safely lift or support.

Sand blast—to blow a stream of high velocity air filled with particles of sand to remove rust or paint from a surface.

Screw plate set—a set of tape and dies used to produce an assorted size of internal and external threads.

Seat—the surfaces of two mating parts which prevent the passage of liquid or gas between them when mated.

Set screw—a screw with a recessed hex cap used to hold two assembled parts together or prevent turning or sliding.

Shear pin—a pin that passes through two mating surfaces and prevents turning under normal load. When the load becomes excessive, the pin shears in two—thereby preventing damage to other parts of the unit.

Sheave—a pulley that a belt runs in. Can be single groove or multiple groove.

Shim—a thin piece of metal used to separate or raise two adjoining surfaces. Usually the material is brass or stainless steel.

Shrink fit—an interference fit where the inner member is contracted by cooling with ice or CO_2 and allowed to expand when installed in the outer member.

Shroud—the band that encloses the tips of fan blades or impeller tips.

Single stage pumps—a pump that produces its entire head with only one impeller.

Sleeve—a thin tubing placed around the shaft of a pump to prevent corrosion of the shaft. The sleeve is made of a material that is compatible with the product.

Sling—a cable used for lifting heavy parts. Usually made of steel, but also made of rope, plastic and cloth.

Slinger ring—a thin disc that is placed on the shaft of a pump to prevent liquid from traveling down the shaft from the stuffing box to the bearing housing. When the liquid reaches the slinger ring, centrifugal force slings it out to the side of the pump.

Spirit level—a level with a vial filled with alcohol. When the bubble is in the center of the vial, the base of the level is perpendicular with the line of gravity.

Sprocket—a wheel which has teeth around the circumference that a chain rides on. The teeth engage the spaces of the chain.

Stainless steel—steels which contain at least 12% chromium. They show no visible signs of rusting.

Stalling—when the steam inlet of a reciprocating pump is equal to the discharge pressure of the pump, stalling occurs.

Stress relieving—process of heating a metal to a point just below its lower critical point and allowing it to cool off slowly.

Stroke—the distance the piston of a pump or engine moves during one half of one cycle.

Studs—bolts that have been threaded on both ends—one end for a nut, the other end for screwing into an internal thread.

Stuffing box—the chamber through which a shaft passes that contains the packing or mechanical seal.

Suction—the action of a reduction in pressure causing atmospheric pressure to push liquid or gas into the suction side of a unit.

Synchronize—to cause two or more parts to function properly in relation to each other.

Tachometer—an instrument which measures revolution per minute.

Take-up—the provisions that were allowed to reduce or increase the distance between centers or gears, sprockets or pulleys.

Tap—a cutting tool used to produce internal threads in a hole.

Tap drill—a drill which is the correct size to prepare a hole for threading with a tap.

Throat bushing—a bushing placed in the bottom of the stuffing box to reduce the flow of liquids into the stuffing box.

Thrust bearing—a bearing which will absorb loads that are along the axis of a shaft (axial loads).

Tolerance—the difference between the maximum and minimum limits of a dimension.

Torque—a force which tends to produce rotation.

Turbine—a machine that converts steam energy into rotary motion. An external combustion engine.

Valve—a device that controls the flow of liquids and gases.

Vibration—a quivering or trembling motion.

Wearing rings—the rings placed around the outer hub of an impeller and inside the casing of a pump. They serve to restrict the amount of liquid that flows from the high pressure side to the suction side of the impeller.

Wiper rings—rings used on reciprocating rods to scrape off excess oil and prevent it from entering the compression cylinder.

Wobble leg—the third leg of a small steam turbine which allows the turbine to expand axially.

Wrench, torque—a wrench with an indicator on the handle that allows a definite amount of force to be applied to a nut or a bolt head.

APPENDIX
MILLWRIGHTING

Machine Tools: America's Muscles, (National Machine Tool Builders' Association: 2139 Wisconsin Avenue, Washington, D. C. 20007). Free.

Opportunities in Machine Shop Trades, (Vocational Guidance Manuals: 235 East 45th Street, New York, New York 10017).

Bureau of Naval Personnel, *Machinery Repairman 3 and 2,* (Superintendent of Documents: U. S. Government Printing Office, Washington, D. C. 20402). (Order No. 0500-141-0110).

Bureau of Naval Personnel, *Machinist's Mate 3 and 2,* (Superintendent of Documents: U. S. Government Printing Office, Washington, D. C. 20402). (Order No. 0500-139-5100).

ADDITIONAL SOURCES OF INFORMATION

United Brotherhood of Carpenters and Joiners of America
101 Constitution Avenue, N.W.
Washington, D. C. 20001.

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ABSTRACT: THE PURPOSE OF THIS INSTRUCTOR'S GUIDE IS TO OUTLINE A SERIES OF TRAINING EXPERIENCES RELATED TO OCCUPATIONS IN ELECTRICITY THAT CAN LEAD A STUDENT TO AT LEAST ENTRY-LEVEL JOB PROFICIENCY. THE GUIDE IS DIVIDED INTO SEVERAL TEACHING UNITS, EACH WITH AN OVERALL OBJECTIVE. THERE ARE FURTHER DIVISIONS LISTING SUBOBJECTIVES WHICH, WHEN SUCCESSFULLY COMPLETED BY THE STUDENT, WILL SATISFY THE OVERALL OBJECTIVE FOR A SPECIFIC UNIT. SUGGESTED ACTIVITIES ARE LISTED UNDER THE SUBOBJECTIVES AND ARE SUPPORTED BY A NUMBER OF TEXTS. SOURCES OF INFORMATION AND AN OUTLINE OF "ACADEMIC RELATED THEORY AND INFORMATION" ARE ALSO INCLUDED IN EACH UNIT. UNIT TITLES FOR THIS GUIDE ARE: RESIDENTIAL WIRING, COMMERCIAL WIRING, AND INDUSTRIAL WIRING. APPENDED IS A SAMPLE LESSON PLAN. THIS DOCUMENT SHOULD BE USED IN CONJUNCTION WITH THE STUDENT MANUAL FOR ELECTRICITY (VT 102 416 IN THIS ISSUE). (AUTHOR/LJ)

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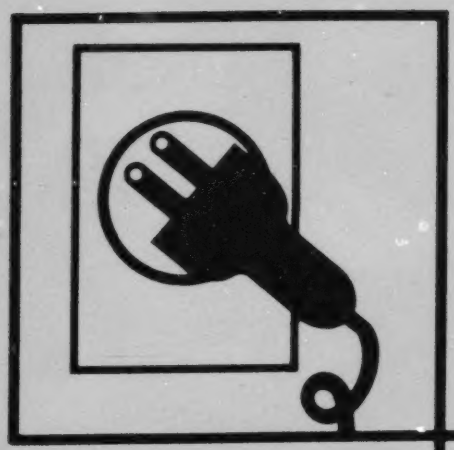
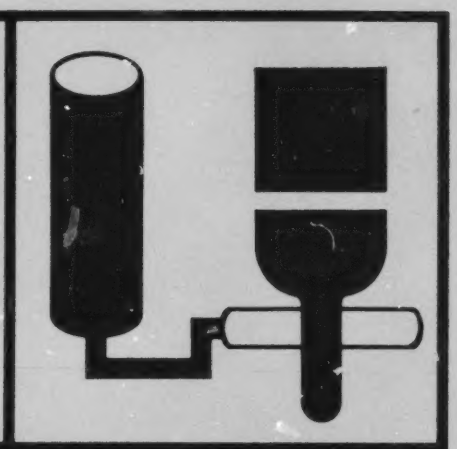
ELECTRICITY





construction industry series
instructor's guide
preparation level

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A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

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Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

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Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
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INTRODUCTION TO ELECTRICITY

OCCUPATIONAL PREPARATION

PURPOSE

The purpose of this guide is to outline a series of training experiences that can lead a student to at least entry-level job proficiency. The instructor guide is divided into several teaching units, each with an overall objective. There are further subdivisions listed as sub objectives which will satisfy the overall objective for a specific unit when successfully completed by the student. Suggested activities are listed under the sub objective and are supported by a number of texts.

Use of behavioral objective format may or may not be new to you. There are a few basic components which acceptable behavioral objectives must include. First, all behavioral objectives must be directed toward student performance. Second, they must clearly state action or behavior which a student must perform. Third, there must be some criteria by which you can measure the success or failure of that action or behavior.

The establishment of a series of measurable goals for each student can individualize the education and training process. If a student can demonstrate skill in certain basic tasks to the satisfaction of the instructor, the student can move on to tasks which are more challenging. Instructing all of your students in the performance of a task, in which many of them are already proficient, can severely affect enthusiasm and motivation. This problem can, in large part, be overcome by the use of a pretest designed to provide a beginning point from which the student can start his or her training. The systematic use of planned instructional outcomes (behavioral objectives) can serve to more effectively motivate students.

The instructor's guide makes no attempt to set down absolute standards defining successful student performance. It will be your responsibility to establish these performance levels for your students. Some performance standards, such as working safety, should probably be set at the 100 percent level. Your professional judgment, and the abilities of your individual students, provide the basis for determining the standard which students must meet before proceeding to another task objective.

PROGRAM APPROACH AND TECHNIQUE

During the exploratory phase of the Construction Program, students are encouraged to explore several job families in construction. As they enter your class, they have made a more refined choice and should now be prepared to develop a number of specific skills.

To accomplish the purpose of this program, a two-fold approach has been taken. The material has been organized into two distinct components -- Instructor's Guide and Student Resource Manuals.

The Instructor's Guide is organized into a task-by-task outlining of suggested activities structured around behavorial objectives.

LESSON PLANNING

Organization and planning are essential to the success of any program. The four-step lesson plan recommended procedure is:

Step 1 Preparation of the Lesson. Applying the principle of Readiness, the instructor should prepare students for the lesson. Information sheets, reading assignments in the text and Student Resource Manual and other introductory techniques can help to prepare the student.

Step 2 Presentation. Applying the principle of Effect, the instructor should present and demonstrate a given process or activity supported by media and selected student involvement. Tell and show how to do the task step-by-step, citing critical check points and special safety requirements.

Step 3 Application of student performance. Applying the principle of Practice, the instructor should permit the students to do the assigned task. Special work sheets, drawings and instructions should be provided the student when necessary.

Step 4 Performance test. Applying the principle of Criteria, referenced testing is used to determine student performance at acceptable levels. Those students who do not meet acceptable performance standards are cycled through Steps 2, 3 and 4 again.

(See Appendix, Sample Lesson Plan)

STUDENT RESOURCE MANUAL

The Student Resource Manual is intended to serve as a supplemental text and information manual. It is designed and written for student use and it is structured to compliment the Instructor's Guide. Subjects such as tools and equipment, materials, processes and safety are discussed. A glossary of terms is included in each student manual.

The success or failure of a preparation program can depend on many things. It is hoped that you will encourage student participation in youth organizations which promote scholarship and craftsmanship. VICA organizations have been very successful in motivating and recognizing student accomplishments. If your school does not have a VICA chapter, you can be instrumental in starting one. The rewards to the community, school, and especially the student, can be readily apparent. Other student organizations, such as DECA, may be of interest to students aiming for careers in the wholesaling and retailing of construction products.

Of further value to your program would be the establishment and maintenance of a strong advisory committee. The involvement of members of the community can help to promote your program. A committee of this kind can form a solid bridge between school and community. If your school does not have a construction advisory committee, it is time to start one. The exchange of ideas can benefit both the school and community.

RESIDENTIAL WIRING

9

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout and install the various pieces of hardware commonly associated with residential wiring.

SOURCES OF INFORMATION

Dickson, William G., ed., Electricity I, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1962.

Electrical Wiring Workbook Parts 1 and 3, California State Department of Education: 721 Capitol Mall, Sacramento, California 95814), Part 1 - 1967, Part 3 - 1969.

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Mileaf, Harry, Electricity One-Seven, (Hayden Book Co., Inc.: 116 W. 14th St., New York, New York 10011), 1967.

Mullin, Ray C., Electrical Trades Blueprint Reading and Sketching Residential, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

National Electrical Code 1971, (National Fire Protection Association:, 60 Batterymarch Street, Boston, Massachusetts 02110).

National Safety Council, (425 North Michigan Avenue, Chicago, Illinois 60611).

Nowak, John F., Practical Residential Wiring, (D. Van Nostrand Co., Inc.: Division of Litton Educational Publications, Inc.: 450 West 33rd Street, New York, New York 10017), 1960.

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ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout and install the various pieces of hardware commonly associated with residential wiring. (Continued)

SOURCES OF INFORMATION

Suffern, Maurice Grayle, Basic Electrical and Electronic Principles, (McGraw Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1962.

Timbie, William H., and Arthur L. Pike, Essentials of Electricity, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1967.

Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout and install the various pieces of hardware commonly associated with residential wiring. (Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Linear measurements
  - Whole numbers
  - Fractions
  - Decimals
  - Addition, subtraction, multiplication and division of whole and fractional numbers
  - Centerline measurements
  - Scale measurements
- Estimation of materials
- Angle measurements

Science

- Conductivity
- Insulation
- Opened and closed circuits
- Resistance
- Meter usage
- Voltage
- Amperage
- Watts
- Alternating current

Communication Skills

- Blueprint reading
  - Interpreting symbols
  - Interpreting work to be done
  - Interpreting specs
  - Introduce National Electrical Code
- Student Resource Manual
- Manufacturer's literature
- Related safety requirements
- Safety related information

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE I: The student will demonstrate ability to flush mount a sectional switch box and an octagonal box for a non-metallic sheathed cable installation on 2" x 4" wood studding.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses electrical box installation.

A. Explain reasons and needs for electrical boxes.
B. Explain different types and sizes of electrical boxes.
C. Explain mounting procedures using bar hangers and 16d nails.
D. Explain reasons for and types of box connectors.
E. Describe special tools and equipment required.
F. Emphasize safety procedures.

II. Instructor demonstrates mounting boxes.

A. Select proper tools and equipment.
B. Check plans for exact location.
C. Mount switch box.
D. Mount bar hanger and attach octagonal box.

III. Students mount boxes.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 2: The student will demonstrate ability to surface mount a utility box, octagonal box and electrical metallic tubing on a masonry surface.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses electrical box installation.

A. Explain different types of masonry surfaces (i.e., concrete, concrete block, etc.)
B. Explain different types of conduit and characteristics of each type.
C. Explain N.E.C. requirements and E.M.T. installation.
D. Explain different types of masonry fasteners (i.e., lead or plastic anchors, toggle bolts, dyna bolts, powder-actuated fasteners).
E. Explain different types of conduit box connectors and couplings.
F. Explain when, how and why bends are made in conduit runs.
G. Describe special tools and equipment required.
H. Emphasize safety procedures.

II. Instructor demonstrates electrical box installation.

A. Select correct tools and equipment needed.
B. Check plan for exact placement of boxes, conduit and locate boxes.
C. Mount boxes.
D. Measure and bend conduit
E. Install conduit and affix box connectors to conduit.
F. Install conduit straps.

III. Students mount boxes and conduit.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 3: The student will demonstrate ability to install an exposed surface extension on a sheetrock wall from an existing outlet of concealed wiring in a masonry wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses surface extension installations using Electrical Metallic Tubing (EMT) and type NM cable.

   A. Explain instances where this situation may be encountered.
   B. Discuss flush box to surface runs and transitions from conduit to cable.
   C. Discuss fastening to drywalls.

II. Instructor demonstrates surface extension installation using type NM cable and EMT.

   A. Check plan or drawing for exact location of surface mounted extension and locate box.
   B. Select tools and equipment.
   C. Mount extension ring.
   D. Determine amount of EMT required.
   E. Cut and bend conduit for a precise fit.
   F. Install EMT box connector with bushing on open end of conduit.
   G. Locate and attach utility box with molly anchors.

III. Students mount surface extension using type NM cable and electrical metallic tubing.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 4: The student will demonstrate ability to connect a keyless lampholder controlled by a single pole switch using non-metallic sheathed cable.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses light and switch installation.

- A. Explain color codes.
- B. Explain methods of grounding.
- C. Discuss planning on paper.
- D. Discuss testing.
- E. Discuss safety.

II. Instructor demonstrates installation of light and switch.

- A. Check drawings for exact location.
- B. Select tools, equipment and materials.
- C. Measure, locate and mount boxes.
- D. Bore holes in studs and joists.
- E. Pull in non-metallic sheathed cable and fasten to box.
- F. Fasten cable to other box with cable clamp or box connector.
- G. Bring in power to box as described.
- H. Fasten cable with staples as prescribed in National Electrical Code, Article 336-5.
- I. Splice cables.
- J. Splice grounding conductors and attach to box.
- K. Fasten wires to switch and light forming wires to tighten loop with screw terminal.
- L. Attach devices to boxes.
- M. Test circuit with ohmmeter.
- N. Insert lamp and apply power.

III. Student installs and connects a keyless lampholder controlled by an SPST switch.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install and connect the hardware, wiring and switching for lighting fixtures (both incandescent and fluorescent) and convenience outlets in a residential installation.

SOURCES OF INFORMATION

Dickson, William G., ed., Electricity I, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1962.

Dickson, William G., ed., Electricity II, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1962.

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Gerrish, Howard H., Electricity, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1964.

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Mullin, Ray C., Electrical Trades Blueprint Reading and Sketching Residential, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

National Electrical Code 1971, (National Fire Protection Association: 60 Batterymarch Street, Boston, Massachusetts 02110).

National Safety Council, (425 North Michigan Avenue, Chicago, Illinois 60611).

Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install and connect the hardware, wiring and switching for lighting fixtures (both incandescent and fluorescent) and convenience outlets in a residential installation. (Continued)

SOURCES OF INFORMATION

Nowak, John F. Practical Residential Wiring, (D. Van Nostrand Co., Inc.: Division of Litton Educational Publications, Inc.: 450 West 33rd Street, New York, New York 10017), 1960.

Suffern, Maurice Grayle, Basic Electrical and Electronic Principles, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1962.

Timbie, William H. and Arthur L. Pike, Essentials of Electricity, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1967.

Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install and connect the hardware, wiring and switching for lighting fixtures (both incandescent and fluorescent) and convenience outlets in a residential installation. (Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Material sizing
  - Wire
  - EMT
  - Boxes
- Measuring
  - Scale measurements
- Ohm's Law computations

Science

- Resistance
  - Circuit load
  - Rheostats
  - Resistors
- Circuits
- Lighting
  - Incandescent
  - Fluorescent
    - Ballast
    - Gases
    - Starters

Communication Skills

- National Electrical Code
- Blueprint reading
- Student Resource Manual
- Manufacturer's literature
- Assigned reading in texts and workbooks
- Safety related information

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 5: The student will demonstrate ability to connect two lighting fixtures controlled from three locations using non-metallic sheathed cable.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses light and switch installation.

   A. Explain and review series-parallel circuits.
   B. Explain 3-way and 4-way connections.

II. Instructor demonstrates light and switch installation.

   A. Check drawings for layout of circuit and location of devices.
   B. Select tools, equipment and materials.
   C. Measure, locate and mount boxes.
   D. Rough-in and splice wiring as per drawing.
   E. Connect and mount lighting fixtures.
   F. Connect and mount 4-way switch.
   G. Connect and mount 3-way switch.
   H. Test circuit.
   I. Insert lamp and apply power.

III. Students install light and switch combination.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 6: The student will demonstrate ability to connect a keyless lampholder controlled from two locations using electrical metallic tubing.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses light and switch installation.

A. Explain and review National Electrical Code requirements for EMT.
B. Discuss use of EMT in residential wiring.
C. Explain EMT bending techniques.
D. Discuss 3-way switch connection.

II. Instructor demonstrates installation of light and switches.

A. Check drawings for layout of circuit and location of devices.
B. Select tools, equipment and materials.
C. Locate, measure and mount 4" octagonal ceiling box.
D. Install conduit.
E. Attach conduit to ceiling box and strap conduit into position.
F. Mount switch box.
G. Pull wire.
H. Bring power into ceiling box.
I. Splice conductors.
J. Connect ground.
K. Connect light fixture.
L. Attach light fixture to ceiling box.
M. Connect 3-way switches.
N. Attach covers.
O. Test circuit.
P. Insert lamp and apply power.

III. Students install a light controlled from two locations.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 7: The student will demonstrate ability to connect a porcelain pull chain lampholder, one lighting fixture controlled by a wall switch and one duplex receptacle to a circuit using type NM cable.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses circuit installation.

- A. Explain wire sizing and relationship between wire size and electrical load.
- B. Explain ampacity reduction factors.
- C. Explain switch ratings.
- D. Explain grounding and grounded conductors.
- E. Explain types and connection of receptacles.
- F. Discuss safety hazards.

II. Instructor demonstrates circuit installation.

- A. Check drawing for layout of circuit and location of devices.
- B. Select tools, equipment and material.
- C. Rough-in boxes.
- D. Rough-in wiring, splice and ground boxes.
- E. Connect and install lighting fixture and switch.
- F. Wire, ground and mount lampholder.
- G. Install receptacle.
- H. Test circuit.
- I. Insert lamps and apply power.

III. Students install and connect circuit.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB-OBJECTIVE 8: The student will demonstrate ability to connect one porcelain pullchain lampholder, two lighting fixtures controlled by individual SPST switches and a switch controlled split-circuit receptacle to the same circuit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses circuit installation.

   A. Explain split-circuit receptacles and their uses.
   B. Explain power and power factors.

II. Instructor demonstrates circuit installation and connection.

   A. Check drawing for layout and location.
   B. Select tools, equipment and material.
   C. Rough-in boxes and wiring.
   D. Splice conductors and ground boxes.
   E. Prepare receptacle for split-circuit service.
   F. Connect and ground duplex receptacle.
   G. Attach lighting fixtures to circuit.
   H. Mount fixtures.
   I. Connect and mount switches.
   J. Attach cover plates.
   K. Test circuit.
   L. Insert lamps and apply power.

III. Students connect and install circuit.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 9: The student will demonstrate ability to correctly install a lighting fixture dimmer.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses operation and installation of various lighting dimmers.

   A. Explain incandescent lamp dimming techniques.
   B. Explain fluorescent lamp dimming techniques.

II. Instructor demonstrates installation of a dimmer control.

   A. Checkdrawing for circuit layout and details.
   B. Rough-in boxes and wiring.
   C. Connect and mount lighting fixtures.
   D. Insert lamps.
   E. Select correct dimmer type.
   F. Connect dimmer and ground box.
   G. Connect circuit to power.

III. Student connects light and dimmer circuit.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 10: The student will demonstrate ability to connect a two-lamp fluorescent fixture controlled by an SPST switch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses electrical circuit installation.

A. Compare incandescent lighting with fluorescent lighting.
B. Explain operation and design of fluorescent lighting systems.
C. Discuss ballast and lamp compatibility.

II. Instructor demonstrates electrical circuit installation.

A. Check drawings for exact location of circuit components.
B. Rough-in boxes and wiring.
C. Connect and mount switch and cover.
D. Inspect lampholders and fixture wiring for damage.
E. Check wiring diagram on ballast for compatibility with existing circuit.
F. Ground fixture.
G. Remove knockout, install fixture and connect.
H. Install lamps, cover or reflector.
I. Test circuit.
J. Apply power.

III. Students install a fluorescent fixture.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to locate circuit malfunctions due to faulty splices, wrong connections, overloading or incorrect resistances, etc. The student will demonstrate the ability to use standard test instruments in performing these tasks and will use knowledge of electrical theory to propose corrections and carry them out to remedy the malfunctions.

SOURCES OF INFORMATION

Dickson, William G., ed., Electricity I, (DelMar Publishers, Inc.: P. O. 5087, Albany, New York), 1962.

Gerrish, Howard H., Electricity, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473). 1964.

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Jones, E. W. and J. L. Johnston, Adequate Wiring for Home and Farm, (The Bruce Publishing Co.: Crowell Collier MacMillan Distribution Center, Front and Brown Streets, Riverside, New Jersey 08075), 1963.

Mileaf, Harry, Electricity One-Seven, (Hayden Book Co., Inc.: 116 West 14th Street, New York, New York 10011), 1967.

Nowak, John F., Practical Residential Wiring, (D. Van Nostrand Co., Inc.: Division of Litton Educational Publications, Inc.: 450 West 33rd Street, New York, New York 10017), 1960.

Suffern, Maurice Grayle, Basic Electrical and Electronic Principles, (McGraw Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1962.

Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to locate circuit malfunctions due to faulty splices, wrong connections, overloading or incorrect resistances, etc. The student will demonstrate the ability to use standard test instruments in performing these tasks and will use knowledge of electrical theory to propose corrections and carry them out to remedy the malfunctions. (Continued)

SOURCES OF INFORMATION

Timbie, William H., and Arthur L. Pike, Essentials of Electricity, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1967.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Meter scale interpolations
- Linear measurements
- Wire sizing
- Fuse and/or circuit breaker sizing

Communication Skills

- Blueprint reading
- National Electrical Code book
- Engineering specs
- Manufacturer's literature

Science

- Resistance
- Shorts
- Continuity
- Ohm's law

Science

- Load carrying capacities of different sized wires
- Grounding principles

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE II: The student will demonstrate ability to connect two porcelain pullchain lampholders, two fluorescent lighting fixtures controlled by individual switches and two convenience receptacles to a 240 volt 3-wire circuit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses circuit installation.

A. Discuss 240 volt 3-wire circuits.
B. Discuss grounding and balancing 3-wire circuits.
C. Discuss open and improperly connected neutrals.
D. Discuss safety.

II. Instructor demonstrates installation and connection of a 3-wire circuit.

A. Check drawings for layout and location of circuit components.
B. Select tools, equipment and materials.
C. Rough-in boxes and wiring.
D. Determine circuit loads and connections.
E. Identify circuits and conductors at points where circuit is to be split.
F. Splice grounding conductors and ground box.
G. Splice conductors so that circuits are balanced.
H. Connect lighting fixtures and attach to boxes.
I. Connect switches to circuits, ground boxes and attach to box; install covers.
J. Test circuit.
K. Insert lamps and apply power.

III. Students install a 3-wire circuit.

ELECTRICITY

CONTENT TITLE: Troubleshooting

SUB OBJECTIVE I2: The student will demonstrate ability to locate a circuit malfunction due to a faulty splice, using a voltmeter.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses methods employed in troubleshooting a faulty circuit.

A. Explain and review electron theory.
B. Explain and review electrical units of measurement.
C. Explain operation and care of voltmeters.
D. Explain difference between AC and DC voltmeters.
E. Explain how to extend the range of a voltmeter.
F. Discuss safety precautions in use and care of voltmeters.
G. Discuss methods of tracing circuits.

II. Instructor demonstrates technique of troubleshooting a circuit.

A. Determine what portion of circuit is inoperative.
B. Determine route of circuit by visual inspection.
C. Check if line voltage is available at each load.
D. Disconnect power when source of information is located.
E. Open splices at point in circuit when malfunction is located.
F. Check all conductors for breaks, signs of arcing, etc.
G. Splice conductors insuring positive contact.
H. Energize circuit and test operation of all components.

III. Student troubleshoots a defective circuit.

ELECTRICITY

CONTENT TITLE: Troubleshooting

SUB OBJECTIVE 13 The student will demonstrate ability to determine the reason for an overload circuit using a split core ammeter.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses methods employed in locating and correcting a circuit overload.

A. Explain and review electron theory.
B. Explain and review electrical units of measurements.
C. Explain and review Ohm's Law.
D. Explain operation and care of ammeters.
E. Explain various types of ammeters.
F. Explain how to extend the range of ammeters.
G. Explain methods of computing circuit and appliance loads.
H. Explain methods of isolating circuit malfunctions.
I. Discuss safety and precautions in troubleshooting energized circuits.

II. Instructor demonstrates methods of locating and correcting circuit overloads.

A. Locate panel board supplying faulty circuit.
B. Remove panel board cover and visually locate tripped circuit breaker.
C. Select highest possible range on ammeter and place split-core around circuit conductor. Caution: Split-core must be around a single conductor only.
D. Reset circuit breaker and energize circuit.
E. Observe meter scale and note maximum reading.
F. Compare ampere load with circuit breaker rating.
G. Compute amount of overload on circuit.
H. Visually identify and check all items connected to the circuit and compute electrical load of each.

Continued...

ELECTRICITY

CONTENT TITLE: Troubleshooting (Continued)

SUB OBJECTIVE I3 The student will demonstrate ability to determine the reason for an overload circuit using a split core ammeter.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Compare actual load readings with connected load.
J. Isolate each portion of circuit and check load (if overload isn't clearly evident when comparison is made).
K. Remove or repair, as necessary, component causing overload.

III. Student locates and corrects circuit overload.

ELECTRICITY

CONTENT TITLE: Troubleshooting

SUB OBJECTIVE 14: The student will demonstrate ability to check the resistance of a circuit using the ohmmeter function of a multimeter.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses methods of checking continuity of a circuit.

A. Explain and review electron theory.
B. Explain and review electrical units of measurement.
C. Explain operation and care of ohmmeter.
D. Explain operation, use and care of multimeters.
E. Discuss safety and precautions in the use and care of multimeters.
F. Discuss need for checking circuit resistance.

II. Instructor demonstrates the methods of checking circuit resistance with a multimeter.

A. Identify circuit to be tested.
B. Disconnect all equipment on circuit.
C. Disconnect power on circuit.
D. Move function switch to D.C. + (this may vary with each meter).
E. Select resistance range to be measured (i.e., Rxl; Rxl0; Rxl00).
F. Adjust zero. (Note: If meter will not zero check for weak batteries inside case).
G. Apply test leads to circuit conductors.
H. Observe resistance reading on meter scale (select a lower scale if necessary).
I. Compare reading obtained with tolerable limits of circuit.

III. Student checks resistance of circuit using a multimeter.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install and connect distribution panel boards, mast type service entrance equipment, underground (concrete slab) service entrance equipment and electric water heaters on separate meters for 24 hour off-peak metering, and to verify the proper operation of this equipment.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

Dickson, William G., ed., Electricity II, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1962.

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Mullin, Ray C., Electrical Trades Blueprint Reading and Sketching Residential, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

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Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install and connect distribution panel boards, mast type service entrance equipment, underground (concrete slab) service entrance equipment and electric water heaters on separate meters for 24 hour off-peak metering, and to verify the proper operation of this equipment. (Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Linear equations
- Ratios and proportions
- Percentages
- Measuring and material layout
- Estimation of materials and equipment
  - Quantity
  - Cost

Science

- Electrical metering systems
- Community electrical distribution systems
- Transformer

Communication Skills

- Interpretation of blueprint
- Interpretation of specs
- National Electrical Code
- Manufacturer's literature
- Local electrical codes
- Instructor designed study sheets

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 15: The Student will demonstrate ability to install a distribution panel board.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses distribution panels.

   A. Discuss purpose and operations.
   B. Discuss types.
   C. Compute the number of circuits and ampacity required of the board.

II. Instructor demonstrates installing a panel board.

   A. Check plans for panel layout and dimensions.
   B. Calculate required number of circuits and ampacity of panel.
   C. Select tools and equipment required.
   D. Make headers and attach panel.
   E. Cut access hole for conduit.
   F. Prepare rigid metallic conduit for installation.
   G. Fasten conduit to panel.

III. Students mount a panel board.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 16: The student will demonstrate ability to use a knockout punch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses types and operation of knockout punches.

II. Instructor demonstrates operation of a knockout punch.

- A. Mark center.
- B. Drill pilot hole.
- C. Assemble knockout punch in pilot.
- D. Cut small hole.
- E. Assemble larger knockout punch.
- F. Cut large hole.

III. Student uses knockout punches.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE I7: The student will demonstrate ability to cut rigid metallic conduit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses use and care of conduit tools.

   A. Pipe threaders.
   B. Pipe cutters
   C. Pipe reamers.

II. Instructor demonstrates operation of a pipe cutter.

   A. Attach pipe to a stand.
   B. Position cutter.
   C. Oil and operate pipe cutter.

III. Student operates a pipe cutter.

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 18: The student will demonstrate ability to ream rigid metallic conduit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates reaming pipe.

A. Insert reamer.
B. Set ratchet pin for clockwise operation.
C. Rotate one turn.
D. Remove reamer.
E. Check for burrs.

II. Student reams a pipe.

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 19: The student will demonstrate ability to thread rigid metallic conduit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates use of a pipe threader.

A. Select correct die size.
B. Insert die into ratchet handle and start thread.
C. Apply oil and continue threading.
D. Repeat oil and turn operation to finish threads.
E. Remove die.

II. Students thread pipe.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 20: The student will demonstrate ability to install a mast type service entrance.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation of mast type service entrance.

A. Explain where mast type service entrances are used.
B. Explain National Electrical Code requirements for service entrances.
C. Explain National Electrical Code requirements for grounding.
D. Explain local electrical ordinances concerning service entrances.
E. Explain method of computing residential loads.
F. Explain and review wire and conduit sizes.
G. Explain procedures for mounting a mast type service entrance.

II. Instructor demonstrates the installation of a mast type service entrance.

A. Compute general lighting and appliance load and demand factors.
B. Compute total residential load to determine size of service switch.
C. Determine correct wire and conduit size to be used.
D. Assemble and mount meter base and service switch. (Note: Mounting height will vary according to locality.)
E. Assemble and mount mast type riser.
F. Pull in and connect wires.
G. Drive ground rod and attach grounding conductor. (Note: Grounding requirements will vary according to locality.)

III. Students install mast type service entrance.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 2I: The student will demonstrate ability to install underground service entrance in concrete slab.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation of underground service entrance.

A. Explain uses of conduit reducing bushings and washers.
B. Explain necessity for accurate measurement.
C. Explain and review computation of residential loads.
D. Explain and review computations of wire and conduit size.
E. Explain methods of fastening conduit prior to concrete pour.
F. Explain importance of having conduit in place before reinforcing steel is installed.

II. Instructor demonstrates installation of underground service entrance.

A. Calculate residential demand load.
B. Select correct size conduit.
C. Install service entrance conduit from pole to house. (Note: Methods and requirements will differ according to locality.)
D. Stub conduit up for mounting meter base and service switch on exterior wall. (Note: Methods will vary according to locality.)
E. Trench through foundation and across forms.
F. Measure exactly where conduit stubs up to panel.
G. Anchor conduit securely to prevent movement during placing of concrete.

III. Student installs an underground service entrance in a concrete slab.

ELECTRICITY

CONTENT TITLE: Rough-In Wiring

SUB OBJECTIVE 22: The student will demonstrate ability to install electric water heaters on separate meter for 24 hour off-peak metering.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation of water heaters.

- A. Explain various sizes and ratings of water heaters.
- B. Explain limited demand water heater connections.
- C. Explain grounding requirements for water heaters.
- D. Explain off-peak water heater metering.
- E. Explain various off-peak metering plans.
- F. Explain effect of voltage variation on heater efficiency.

II. Instructor demonstrates the installation of a 24 hour off-peak electric water heater.

- A. Compute the heater load demand.
- B. Determine heater circuit requirements.
- C. Mount main and off-peak meter bases.
  (Note: Requirements will vary according to locality.)
- D. Mount main and water heater service switches.
- E. Rough-in and connect service cables.
- F. Ground water heater.

III. Students install a water heater with 24 hour off-peak metering.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install, connect and test the operation of the circuit breaker equipment in a residential application.

SOURCES OF INFORMATION

Electrical Wiring Workbook Parts I and 3, (California State Department of Education: 721 Capitol Mall, Sacramento, California 95814), Part I - 1967, Part 3 - 1969.

Jones, E. W. and J. L. Johnston, Adequate Wiring for Home and Farm, (The Bruce Publishing Co.: Crowell Collier MacMillan Distribution Center, Front and Brown Streets, Riverside, New Jersey 08075), 1963.

Mullin, Ray C., Electrical Trades Blueprint Reading and Sketching Residential, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

National Electrical Code 1971, (National Fire Protection Association: 60 Batterymarch Street, Boston, Massachusetts 02110)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring and material layout
- Sizing of materials and equipment
- Linear equations

Communication Skills

- Schematic drawing interpretation
- National Electrical Code
- Draw working drawings
- Local electrical codes
- Instructor designed information sheets
- Blueprint interpretation

Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install, connect and test the operation of the circuit breaker equipment in a residential application. (Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Electrical circuits (115 V and 230 V)
- Function and operation of circuit breakers and fusing devices
- Grounding

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out

SUB OBJECTIVE 23: The student will demonstrate ability to install circuit breakers in panel board, connect circuits, label panel and mount cover.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses procedures to follow in panel board trim out.

A. Explain types of panel boards, i.e., bolt-on type breakers, plug-in type breakers, etc.
B. Explain panel board ratings, i.e., main-bus ratings.
C. Explain types, styles and ratings of circuit breakers.
D. Explain types, styles and ratings of fuses.
E. Discuss methods of balancing loads in panel boards.
F. Explain methods of connecting and identifying circuits.
G. Explain National Electrical Code requirements for panelboard installations.
H. Explain panelboard grounding requirements.

II. Instructor demonstrates method of trimming out a panelboard.

A. Plan and layout circuit connections.
B. Attach circuit breakers to main bus assembly.
C. Identify all 120 volt circuits.
D. Connect the unidentified conductors to the single pole circuit breakers. (Note: Pay particular attention to circuit load and balance.)
E. Connect identified conductors and grounding conductors to solid neutral bus.
F. Identify all 240 volt circuits.
G. Connect both insulated conductors to double pole, common trip breakers. (Note: Neatly form and uniformly route all circuits within panel. Allow approximately 8" extra length in each conductor.)

Continued...

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out (Continued)

SUB OBJECTIVE 23: The student will demonstrate ability to install circuit breakers in panel board, connect circuits, label panel and mount cover.

SUGGESTED ACTIVITIES: (Students and Teachers)

H. Connect all grounding conductors to the solid neutral bus.
I. Double check all connections for tightness.
J. Attach panel board cover. (Note: Make sure the cover clamps or screws do not damage conductor insulation.)
K. Label circuits on legend card in panel door.

III. Students install circuit breakers and mount panel cover.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to install and connect electrical service to electrically operated kitchen equipment such as electric ranges, cook-top units, built-in ovens, garbage disposals and electric clothes washers and dryers.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

Dickson, William G., ed., Electricity I, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1962.

Jones, E. W. and J. L. Johnston, Adequate Wiring for Home and Farm, (The Bruce Publishing Co.: Crowell Collier MacMillan Distribution Center, Front and Brown Streets, Riverside, New Jersey 08075), 1963.

Mullin, Ray C., Electrical Trades Blueprint Reading and Sketching Residential, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

National Electrical Code 1971, (National Fire Protection Association: 60 Batterymarch Street, Boston, Massachusetts 02110).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Linear equations
- Measuring with accuracy
- Computing costs of equipment and discounts

Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to install and connect electrical service to electrically operated kitchen equipment such as electric ranges, cook-top units, built-in ovens, garbage disposals and electric clothes washers and dryers. (Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Voltage drop
- Acceptable grounding techniques
- Overload protective devices
- Reset devices
- Electric motor and components

Communication Skills

- Manufacturer's literature
- National Electrical Code
- Local electrical code
- Blueprint interpretation
- Interpretation of equipment and schematics
- Related safety information

ELECTRICITY

CONTENT TITLE: Finishing Wiring and Trim Out

SUB OBJECTIVE 24: The student will demonstrate ability to install and connect a cook-top unit and built-in oven.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation of cook-top unit and built-in oven.

A. Explain causes of line drop (Voltage drop).
B. Explain methods of reducing line drop.
C. Explain causes and effects of line loss.
D. Explain installation of cook-top unit.
E. Explain installation of built-in oven.
F. Explain grounding procedures.
G. Explain demand factors for ovens and cook-top units.
H. Explain group circuit requirements.
I. Explain need for coordination of work with other trades.

II. Instructor demonstrates installation and connection of a cook-top unit and build-in oven.

A. Calculate circuit requirements for each appliance.
B. Rough-in boxes and wiring. Install 4' square box behind each unit.
C. Attach circuit conductors to appliance wiring.
D. Ground appliances by connection to the #10 AWG or larger grounded circuit conductor. (Note: This requirement may vary according to locality.)
E. Install box covers and slide appliances into place.

III. Students install and connect a cook-top unit and built-in oven.

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ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out

SUB OBJECTIVE 25: The student will demonstrate ability to connect and install a garbage disposal unit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses factors relating to the installation of a garbage disposal unit.

   A. Explain electrical circuit requirements for garbage disposal units.
   B. Explain integral over-current protection.
   C. Compare installation of garbage disposals to other appliances requiring separate circuits: Dishwashers, washers, refrigerator freezers, range hood units.
   D. Explain grounding requirements.
   E. Explain installation techniques for each appliance.

II. Instructor demonstrates the connection of a garbage disposal unit.

   A. Plan and layout circuit for garbage disposal.
   B. Rough-in boxes and wiring.
   C. Connect and mount motor control switch in designated location. (Note: Requirements for disconnecting may vary according to locality.)
   D. Connect circuit conductors to disposal leads.
   E. Connect grounding conductor to unit with a grounding clip. (Note: Grounding requirements may differ according to locality.)

III. Students connect and install a garbage disposal unit.

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out

SUB OBJECTIVE 26: The student will demonstrate ability to connect and install an electric clothes dryer.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation procedure for an electric clothes dryer.

   A. Explain clothes dryer circuit requirement.
   B. Explain dryer receptacle and cord.
   C. Explain and review 240 volt 3-wire circuits.
   D. Compare dryer installation with other 240 volt 3-wire units (i.e. well pump).
   E. Explain computation of branch circuit protection for motor operated appliances.
   F. Explain computation of running overcurrent protection for motor operated appliances.
   G. Explain grounding requirements for clothes dryer.

II. Instructor demonstrates installation procedure for an electric clothes dryer.

   A. Check appliance name plate to determine circuit load.
   B. Rough-in boxes and wiring.
   C. Connect dryer receptacle to circuit.
   D. Attach dryer cord to unit terminals.
   E. Ground dryer frame to grounding conductor.
   F. Level dryer.

III. Students connect and install dryer.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install, connect and test the operation of various combination standard and low voltage (servo operated) electrical systems such as electric furnaces, natural gas furnaces, air conditioning equipment, door chimes and low voltage remote-controlled lighting systems.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

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Dickson, William G., ed., Electricity I, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1962.

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Mileaf, Harry, Electricity One-Seven, (Hayden Book Co., Inc.: 116 West 14th Street, New York, New York 10011), 1967.

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Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install, connect and test the operation of various combination standard and low voltage (servo operated) electrical systems such as electric furnaces, natural gas furnaces, air conditioning equipment, door chimes and low voltage, remote-controlled lighting systems. (Continued)

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Suffern, Maurice, Grayle, Basic Electrical and Electronic Principles, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1962.

Timbie, William H. and Arthur L. Pike, Essentials of Electricity, (John Wiley and Sons, Inc.: 605 3rd Avenue, New York, New York 10016), 1967.

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ACADEMIC RELATED THEORY AND INFORMATION

Math

- Using catalog and manufacturer's numbers
- Computing costs and discounts
- Estimating time and labor costs

Communication Skills

- Written and oral transfer of technical data (material ordering)
- Equipment schematics
- Interpretation of blueprints and engineering specs

Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install, connect and test the operation of various combination standard and low voltage (servo operated) electrical systems such as electric furnaces, natural gas furnaces, air conditioning equipment, door chimes and low voltage, remote-controlled lighting systems. (Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Transformers
- Low voltage circuits and controls
  - Thermostats
  - Rectifiers
  - Relays
- Electric motors and components

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out

SUB OBJECTIVE 27: The student will demonstrate ability to connect a 15 kw electric furnace and associated controls.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses types and operations of various electric heating devices.

II. Instructor demonstrates the proper method of connecting an electric furnace and controls.

A. Check blueprints, specifications and drawings for exact location of units.
B. Check furnace name plate and wiring schematic for wiring requirements.
C. Compute wire size, number of circuits and overcurrent protection required.
D. Rough-in wiring from panel to electric furnace.
E. Connect circuits into furnace according to schematic furnished with furnace. (Note: Time delay relays or other devices are usually an integral part of the furnace.)
F. Rough-in low voltage wiring between thermostat and furnace.
G. Connect circuits according to schematic furnished with furnace. (Note: The low voltage transformer is usually an integral part of the electric furnace.)
H. Connect a two-stage thermostat and mount on wall. (Note: Thermostat should be mounted on an interior wall, centrally located and out of drafts. Local codes and ordinances will vary on type of thermostatic control required.)
I. Energize circuit and check all functions.

III. Students connect an electric furnace with thermostatic control.

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out

SUB OBJECTIVE 28: The student will demonstrate ability to install wiring and connect a natural gas furnace coupled with a central air conditioning unit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the wiring and connections for a heating and air conditioning system.

   A. Discuss types and operation of heating and equipment and their components.
   B. Illustrate computation of wire breaker and switch size.
   C. Outline areas of responsibility for electrician and heating and cooling systems installers.

II. Instructor demonstrates the correct installation procedure for heating and air conditioning systems.

   A. Check plans and specifications for location of units and circuit requirements, (if available).
   B. Check nameplate ratings on furnace A/C unit to determine circuit requirements. (Note: Heating and A/C units are normally set in place by heating and A/C contractors.)
   C. Plan and layout circuits.
   D. Rough-in wiring and boxes from panel board to equipment location.
   E. Rough-in low voltage wiring from thermostat to heating and A/C units.
   F. Connect line voltage wiring to heating and fan unit. (Note: This is normally accomplished by means of a plug and receptacle.)
   G. Connect control circuit wiring according to diagram furnished with the heating unit. (Note: Some manufacturers require a separate switching relay for the fan unit if it is used with A/C.)

Continued...

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out (Continued)

SUB OBJECTIVE 28: The student will demonstrate ability to install wiring and connect a natural gas furnace coupled with a central air conditioning unit.

SUGGESTED ACTIVITIES: (Students and Teachers)

H. Mount and connect a fused disconnect switch near the A/C unit location, on the exterior wall. (Note: Requirements may vary according to local codes.)

I. Mount junction box on exterior wall and feed in control cable.

J. Bend and install conduits between switch box, junction box and A/C unit.

K. Fish in wiring through both conduits to A/C units.

L. Connect line voltage and low voltage terminals according to diagram furnished with A/C unit.

M. Connect and mount thermostat. (Note: Low voltage transformer is normally supplied with the heating and fan unit.)

N. Energize circuit and check each component for proper operation.

III. Students connect wiring for a heating and A/C unit.

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out

SUB OBJECTIVE 29: The student will demonstrate ability to install a door chime with front and back door buttons.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation procedures for door chimes.

A. Discuss types and operation of signal devices.
B. Explain National Electrical Code requirements for signal circuits and installation of transformers.
C. Explain precautions in stapling low voltage cable.
D. Explain other types of residential signaling devices.

II. Instructor demonstrates installation procedure for door chimes.

A. Check blueprint for exact location of chimes, push-button units and transformer. (Note: Location of transformer may be governed by local ordinance.)
B. Rough-in power circuit to transformer box.
C. Rough-in low voltage wiring. (Note: Exercise care in stapling.)
D. Connect circuit to push-buttons and mount buttons to surface.
E. Connect control wires and circuit wires at chime location.
F. Connect control wires to chime unit and mount on wall.
G. Connect grounding conductor to transformer box.
H. Connect circuit wires to transformer and mount on box. (Mounting will differ with style of transformer.)
I. Connect low voltage wires to low voltage transformer.

III. Students install and connect a door chime unit with front and back door signaling indication.

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out

SUB OBJECTIVE 30: The student will demonstrate ability to install a low voltage remote control lighting system with a 9-station master control switch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation of a low voltage remote control lighting system.

   A. Explain the operating principles of a low voltage remote control system.
   B. Discuss characteristics of this type system.
   C. Discuss components (i.e., transformers, rectifiers) of low voltage systems.
   D. Explain local electrical ordinances governing low voltage remote control systems.

II. Instructor demonstrates the correct installation procedure for low voltage remote control lighting systems.

   A. Check plans for location of fixtures, switches and power supply.
   B. Rough-in boxes and wiring for 120 volt system.
   C. Rough-in 4 inch square box for mounting of transformer.
   D. Rough-in necessary low voltage wiring. (Note: Some localities may require boxes at switch locations.)
   E. Insert low voltage relay into one of the 1/2" knockouts at each light on receptacle box location. (Note: Some manufacturers incorporate the transformer within the relay.)
   F. Splice low voltage switch legs, low voltage power supply leads and low voltage relay leads in proper sequence. (Note: Carefully observe color code or terminal markings.)
   G. Splice 120 volt power leads inside boxes and attach fixtures or receptacles to box.

Continued...

CONTENT TITLE: Finish Wiring and Trim Out (Continued)

SUB OBJECTIVE 30: The student will demonstrate ability to install a low voltage remote control lighting system with a 9-station master control switch.

SUGGESTED ACTIVITIES: (Students and Teachers)

H. Connect switch leg conductors to each switch.
I. Mount switches on raised plaster ring selected for thickness of finished wall.
J. Fasten raised plaster ring to wall studs or lath.
K. Identify each circuit and connect to master selector switch.
L. Fasten master selector switch to wall in same manner as individual switches.
M. Connect power to transformer and mount on 4" square box.
N. Connect two voltage leads to secondary terminals.

III. Students install a low voltage remote control lighting system with 9-station master control.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install, connect and test the operation of low-voltage equipment in residential applications such as radio and intercom systems and TV antenna distribution systems.

SOURCES OF INFORMATION

Mullin, Ray C., Electrical Trades Blueprint Reading and Sketching Residential, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

National Electrical Code 1971, (National Fire Protection Association: 60 Batterymarch Street, Boston, Massachusetts 02110).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring and layout

Science

- Intercom and radio circuits
- Antenna system

Communication Skills

- Interpreting blueprints and engineering specs
- Manufacturer's literature
- National Electrical Code
- Local electrical code
- Schematic drawings

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out

SUB OBJECTIVE 3I: The student will demonstrate ability to install and connect a complete radio and intercom system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses methods and techniques of installing various types of intercom systems.

   A. Explain operation of an intercom system.
   B. Explain installation techniques for an intercom system.
   C. Explain various types of intercom systems.
   D. Explain precautions to follow when installing an intercom system.
   E. Explain proper positioning of speakers.

II. Instructor demonstrates the proper method of installing a radio/intercom system.

   A. Check blueprint or specifications for type of radio/intercom system to be installed.
   B. Check for location of master control station and slave stations.
   C. Rough-in boxes and wiring. (Note: Boxes and wiring must match system being installed. Wiring between master and slave stations should not run adjacent to or touch house wiring cables.)
   D. Mount stepdown transformer in panel board.
   E. Connect line side of transformer. (Note: The installation of radio/intercom systems will vary according to locality.)
   F. Rough-in low voltage cable from transformer to master station.
   G. Connect power leads to unit input leads.

Continued...

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out (Continued)

SUB OBJECTIVE 3I: The student will demonstrate ability to install and connect a complete radio and intercom system.

SUGGESTED ACTIVITIES: (Students and Teachers)

H. Identify each circuit and connect to master control unit.
I. Connect remote speakers and mount on boxes. (Note: Normally the speaker is designed for a surface mount.)
J. Connect master unit to existing antenna or mount an antenna in the attic.
K. Energize circuit and check operation of each unit.

III. Students install a radio/intercom system.

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out

SUB OBJECTIVE 32: The student will demonstrate ability to install and connect a TV antenna and lead-in cable.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses the installation and connection of TV lead-in wiring.

   A. Explain methods of grounding antenna masts and lightning protection.
   B. Discuss different types of lead-in cables.
   C. Point out precautions to follow when using unshielded lead-in wires.
   D. Discuss advantages of coaxial cable.
   E. Explain operation and connection of antenna rotors.
   F. Mention master amplifier distribution systems and multi-set couplers.

II. Instructor demonstrates the installation and connection technique for a TV lead-in cable.

   A. Check blueprints, specifications or drawings for location of antenna and TV outlets.
   B. Install antenna mast and antenna. (Note: Local codes or ordinances may prohibit electrician from doing this work.)
   C. Rough-in all lead-in cable. (Note: Maintain distance between lead-in cable and A.C. conductors as well as metallic objects.)
   D. Mount the multi-set coupler in a convenient location and connect lead-in cables according to diagram furnished with the coupler. (Note: Normally this coupler will be mounted in the attic near where the antenna lead-in enters the building.)
   E. Ground antenna mast to a driven grounding electrode. (Note: Grounding requirements may vary according to locality.)

Continued...

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out (Continued)

SUB OBJECTIVE 32: The student will demonstrate ability to install and connect a TV antenna and lead-in cable.

SUGGESTED ACTIVITIES: (Students and Teachers)

F. Install lightning arrestor on antenna mast and ground to driven grounding electrode. (Note: Requirements for lightning protection may vary according to locality.)
G. Connect lead-in cable to antenna.
H. Connect lead-in cable to specially designed TV outlet. (Note: Local codes or ordinances may require boxes.)

III. Students install and connect a TV antenna and lead-in cable.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout, install and connect electrical service for luxury features such as overhead garage door openers and electric yard lights with photo-electric control.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

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National Electrical Code 1971, (National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts 02110).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring and layout
- Computation of costs
- Material estimation
- Formulation of bills

Communication Skills

- Interpreting manufacturer's information
- Interpreting schematic drawings
- Written and oral communications of technical data

Science

- Special electrical switches
  - Photo-electric cells
  - Weight switches

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out

SUB OBJECTIVE 33: The student will demonstrate ability to install and connect overhead garage door openers with a keyed operator and a push-button station.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation procedures for overhead garage door openers.

A. Explain operation of garage door openers.
B. Explain different types of garage door openers.
C. Explain different types and styles of door operators.
D. Explain use of box cover fuse and switch units for disconnecting and over current protection.
E. Explain adjustment of limit switches.
F. Explain operation of the electrically operated reversing switch.
G. Explain connection and operation of motor control circuits.

II. Instructor demonstrates the installation techniques of a key operated garage door opener.

A. Calculate circuit requirement, over current and running protection required.
B. Layout circuit and locate control stations.
C. Rough-in boxes and cable. (Note: Requirements for underground installations will vary.)
D. Install type F S box or equivalent at driveway location.
E. Pull in 3 conductors with ground.
F. Connect keyed operator to circuit and mount weather proof cover.
G. Install special box designed for push button unit inside garage.
H. Connect push button station to circuit and mount.
I. Mount and connect limit switches.

Continued...

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out (Continued)

SUB OBJECTIVE 33: The student will demonstrate ability to install and connect overhead garage door openers with a keyed operator and a push-button station.

SUGGESTED ACTIVITIES: (Students and Teachers)

J. Connect all wires in master control box.
K. Connect and mount box cover fuse and switch unit.
L. Energize circuit and adjust limit switches.

III. Students install an overhead garage door opener with operators.

ELECTRICITY

CONTENT TITLE: Finish Wiring and Trim Out

SUB OBJECTIVE 34: The student will demonstrate ability to install a yard light with photo-electric control.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses a typical yard light and photo-electric cell installation.

   A. Explain operation of photo-electric cells.
   b. Explain various methods of yard and area lighting.
   C. Discuss types of light sources, such as mercury vapor, metallic vapor, sodium vapor, quartz iodine, incandescent and their characteristics.
   D. Discuss lighting design.

II. Instructor demonstrates installation of a yard light with photo-electric control.

   A. Check plan for exact location of yard light.
   B. Install conduit if necessary from panel to edge of building foundation and below grade level.
   C. Dig tranch from edge of building to location of yard light.
   D. Place sand in bottom of trench.
   E. Pull in type UF cable and cover with sand.
   F. Bend conduit to fit from bottom of trench up approximately 12 inches above grade level.
   G. Install LB conduit and nipple in side of yard lamp post..
   H. Pull in UF cable.
   I. Mount photo-electric control in side of post, near top for accessibility.
   J. Splice connections and tie in photo-electric control.
   K. Install lamp and attach fixture to top of post.

III. Students install a yard light with photo-electric control.

COMMERCIAL WIRING

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to install (in compliance with National Electrical Code restrictions) tri-plex cable, mineral-insulated metal-sheathed cable, electrical metallic tubing (EMT), liquid-tight flexible conduit and rigid metal conduit.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

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Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to install (in compliance with National Electrical Code restrictions) tri-plex cable, mineral-insulated metal-sheathed cable, electrical metallic tubing (EMT), liquid-tight flexible conduit and rigid metal conduit. (Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Scale measurements
- Materials estimation
  - Unit costs
  - Discounts
- Linear measurements
- Electrical material sizing

Science

- Amperage
- Volts
- Watts
- Grounding
- Current capacity of wire
- Conductors
- Insulators

Communication Skills

- Blueprint reading and symbols
- National Electrical Code
- Manufacturer's literature
- Working drawings
- Related safety

ELECTRICITY

CONTENT TITLE: Wiring Methods

SUB OBJECTIVE I: The student will demonstrate ability to install correctly tri-plex cable.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing tri-plex cable.

- A. Describe National Electrical Code (NEC) restriction on use of this cable.
- B. Install porcelain screw insulators on supports.
- C. Attach cable strain clamps to insulators.
- D. Measure and cut cable to specified length.
- E. Attach cable messenger wire to strain clamps.

II. Student installs tri-plex cable.

CONTENT TITLE: Wiring Methods

SUB OBJECTIVE 2: The student will demonstrate ability to install correctly metal sheathed cable.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing metal sheathed cable.

- A. Discuss National Electrical Code restrictions on use of metal sheathed (M1) cable.
- B. Cut cable.
- C. Remove specified length of outer sheath.
- D. Seal cable end.
- E. Insulate individual conductors.
- F. Attach cable to outlet box.

II. Student installs M1 cable.

ELECTRICITY

CONTENT TITLE: Wiring Methods

SUB OBJECTIVE 3: The student will demonstrate ability to perform basic EMT operations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installation of EMT.

A. Discuss National Electrical Code material relevant to EMT.
B. Select specified size of EMT.
C. Measure for specific length.
D. Cut to specified length using hacksaw.
E. Remove burrs using slip joint pliers.
F. Attach to outlet box using EMT connector.
G. Couple EMT to EMT using EMT coupling.

II. Student performs basic conduit operations.

CONTENT TITLE: Wiring Methods

SUB OBJECTIVE 4: The student will demonstrate ability to perform flexible metal conduit operations.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor identifies flexible metal conduit operations.

A. Describe National Electrical Code restrictions on use of flexible conduit.
B. Measure conduit to determine size.
C. Cut conduit using hacksaw.
D. Remove burred edges from conduit end.
E. Install flexible conduit connector.
F. Attach connector to outlet box.

II. The student performs flexible metal conduit operations.

ELECTRICITY

CONTENT TITLE: Wiring Methods

SUB OBJECTIVE 5: The student will demonstrate ability to correctly install liquid tight flexible metal conduit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates working with liquid tight flexible metal conduit.

   A. Discuss National Electrical Code restrictions in its use.
   B. Measure conduit for size.
   C. Cut to prescribed length.
   D. Install liquid tight flexible connector in threaded hub function box.
   E. Disassemble flexible connector.
   F. Insert flexible conduit.
   G. Reassemble and tighten flexible connector.

II. Student works with liquid tight flexible metal conduit.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout and install conduit in concrete forms.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

Fisher, Electrical Trades Blueprint Reading and Sketching Industrial, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

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Nowak, John F., Practical Residential Wiring, (D. Van Nostrand Co., Inc.: Division of Litton Educational Publications, Inc.: 450 West 33rd Street, New York, New York 10017), 1960.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Linear measurements
- Scale measurements
- Electrical material sizing
- Plumb, level and square
- Angles and degrees

Communication Skills

- Blueprint interpretation
- Engineering specs
- National Electrical Code
- Manufacturer's literature

ELECTRICITY

CONTENT TITLE: Installing Conduit in Concrete

SUB OBJECTIVE 6: The student will demonstrate ability to draw a rough deck layout for floor fed wall outlets on plywood deck.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates drawing a rough deck layout.

A. Draw partial plan.
B. Transfer room dimensions found on general prints to sketch.
C. Referring to electrical print, mark approximate location of outlets.
D. Using scale rule, measure exact location of each outlet as shown on electrical plan, and mark on sketch.
E. Using National Electrical Code, calculate sizes of conduit required.
F. Transfer distance and height of risers from plan to drawing.

II. Students make a rough deck sketch.

ELECTRICITY

CONTENT TITLE: Installing Conduit in Concrete Forms

SUB OBJECTIVE 7: The student will demonstrate ability to make a worksheet sketch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates making a worksheet sketch.

A. Draw conduit run showing types, locations and degree of bends.
B. Measure and mark distance between bends.
C. Note relative position of one bend to another.
D. Note size of conduit to be used.

II. Students complete a worksheet sketch.

CONTENT TITLE: Installing Conduit in Concrete Forms

SUB OBJECTIVE 8: The student will demonstrate ability to make a deck layout for floor-fed wall outlets.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor transfers sketch information to floor.

A. Mark off reference partition at one end of clear area.
B. Measure and mark off location of both ends of wall lines.
C. Snap continuous wall lines from reference mark to reference mark.
D. Measure and mark off location of each outlet on wall line.
E. Determine height of risers and outlets and mark at each location.
F. Mark size of conduit beside symbols.

II. Students transfer sketches to floor.

ELECTRICITY

CONTENT TITLE: Installing Conduit in Concrete Forms

SUB OBJECTIVE 9: The student will demonstrate ability to prefabricate conduit for deck, ceiling and wall outlets.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates prefabricating conduit for deck, ceiling and wall outlets.

   A. Bend and fit each conduit run to outlets on deck layout.
   B. Tag and identify each run from conduit routing sketch (detailed sketch from last exercise).
   C. Plug ends of conduit.

II. Student prefabricates conduit for deck, ceiling and wall outlets.

ELECTRICITY

CONTENT TITLE: Installing Conduit in Concrete Forms

SUB OBJECTIVE 10: The student will demonstrate ability to run prefabricated conduit to ceiling-fed and floor-fed outlets.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor installs conduit to floor-fed and ceiling-fed outlets.

   A. Nail ceiling mounted concrete ring boxes and recessed fixture cans to deck at predetermined locations.
   B. Place prefabricated conduit runs as indicated by tags and conduit routing sheet.
   C. Attach conduits to outlet boxes.
   D. Tie conduits securely to steel mat, reinforcing steel.
   E. Install wall mounted outlet boxes.
   F. Plug ends of all conduit runs and pack ceiling boxes.
   G. Install covers on boxes.

II. Student installs conduit to floor-fed and ceiling-fed outlets.

ELECTRICITY

CONTENT TITLE: Installing Conduit in Concrete Forms

SUB OBJECTIVE II: The student will demr .e ability to correctly install con outlets in concrete columns

SUGGESTED ACTIVITIES: (Students and Teache

I. Instructor discusses techniques for determinir e type and location of outlets, type of outlet boxes requi:ed and the size and routing of the circuit.

II. Instructor demonstrates installation of conduit and outlets in concrete columns or walls.

A. Determine type and location of outlet.
B. Determine size and routing of conduit.
C. Mark location of outlet on form.
D. Draw sketch of conduit run.
E. Bend and fit conduit to form.
F. Seal conduit and pack outlet boxes.
G. Secure outlet box to column form.
H. Secure conduit to reinforcing steel.

III. Students install circuit in concrete columns or walls.

ELECTRICITY

CONTENT TITLE: Installing Conduit in Concrete Forms

SUB OBJECTIVE 12: The student will demonstrate ability to locate and install pipe sleeves in concrete beam forms.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing a pipe sleeve in a concrete beam form.

   A. Measure and mark location of sleeve in short section of beam form.
   B. Mark circle on beam form using pipe sleeve as a template.
   C. Bore hole through beam form on inner edge of circle using brace and bit.
   D. Saw circular hole in form using compass saw.
   E. Push sleeve through hole to opposite side of beam form.
   F. Level and square sleeve in beam using tri-square.
   G. Locate and saw hole on opposite side of beam form.
   H. Insert sleeve through both holes in beam form and wedge in place with 16d nail.

II. Student locates and installs a pipe sleeve in a concrete beam form.

ELECTRICITY

CONTENT TITLE: Conduit Bending

SUB OBJECTIVE 13: The student will demonstrate ability to make kicks, off-sets, saddles and 90° bends in 1/2" rigid conduit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates making a 90° bend.

A. Determine desired height of riser.
B. Measure height of riser, add correct pipe loss factor and mark conduit.
C. Set hook at mark and start bend.
D. Set protractor level on riser and monitor bend at intervals.
E. Pull to 90° and release tension.
F. If spring back causes error, increase bend slightly, repeating as necessary to get 90°.

II. Student makes a 90° bend.

III. Instructor demonstrates bending, kicks, off-sets and saddles.

A. Layout necessary length; allow for end losses and mark.
B. Set bends on mark and make bend.
C. Check bend with protractor level.
D. Correct slight errors until bend angles are correct.

IV. Students practice making kicks, off-sets and saddles.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to plan, layout and install a floor duct system.

SOURCES OF INFORMATION

Electrical Wiring Workbook Parts I and 3, (California State Department of Education: 721 Capitol Mall, Sacramento, California 95814), Part I - 1967, Part 3 - 1969.

National Electrical Code 1972, (National Fire Protection Association: 60 Batterymarch Street, Boston, Massachusetts 02110).

Walkerduct Systems, (Walker-Parkersburg: P. O. Box 1828, Parkersburg, West Virginia), Catalog No. 864.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Linear measurements
- Scale measurements

Communication Skills

- Making and interpreting working drawings
- National Electrical Code
- Manufacturer's literature

ELECTRICITY

CONTENT TITLE: Floor Ducts

SUB OBJECTIVE 14: The student will demonstrate ability to layout a floor duct system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses floor duct systems, pointing out their functions and their basic parts.

II. Instructor lays out a floor duct system.

A. Prepare working drawing.
B. Transfer drawing to deck.
C. Mark size of feeder conduit, locations of junction boxes and interconnect duct runs.

III. Student lays out a floor duct system.

ELECTRICITY

CONTENT TITLE: Floor Ducts

SUB OBJECTIVE 15: The student will demonstrate ability to install a floor duct system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installation of a floor duct system.

A. Anchor junction boxes at prescribed locations.
B. Cut and fit interconnecting duct between J-boxes.
C. Seal all joints.
D. Install and anchor support brackets in interconnecting duct.
E. Adjust J-box and duct brackets to approximate height.
F. Install marker screws.
G. Level and make final adjustments for height of all J-boxes, duct brackets and marker screws.

II. Student installs a floor duct system.

ELECTRICITY

OVERALL OBJECTIVE: The student wil' demonstrate ability to plan, layout and install conduit for installation in and on drywalls and masonry walls.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

Fisher, Electrical Trades Blueprint Reading and Sketching Industrial. (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

National Electrical Code 1972, (National Fire Protection Association: 60 Batterymarch Street, Boston, Massachusetts 02110).

Nowak, John F., Practical Residential Wiring, (D. Van Nostrand Co., Inc.: Division of Litton Educational Publications, Inc.: 450 West 33rd Street, New York, New York 10017), 1960.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Linear measurements
- Angles and degrees
- Plub, level and square

Communication Skills

- Technical literature
- Engineering specs
- Blueprints
- National Electrical Code

ELECTRICITY

CONTENT TITLE: Drywall Installation

SUB OBJECTIVE 16: The student will demonstrate ability to install outlet boxes on conduit previously stubbed from a concrete floor.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation of conduit and outlet boxes in masonry and drywalls.

   A. Discuss meeting building specifications.
   B. Discuss meeting National Electrical Code specifications.
   C. Discuss need for careful installation.

II. Instructor demonstrates installing conduit and outlet boxes on drywalls.

   A. Measure and strike-off wall line.
   B. Adjust conduit stubs using two conduit hickeys.
   C. Determine type and height of outlet from electrical prints.
   D. Measure and cut conduit nipples to extend conduit (nipple-up stubs).
   E. Install conduit nipples and outlet box.
   F. Adjust conduit stubs to flush box.
   G. Using a plumb-bob, adjust box position to the wall line and level.

III. Student, using conduit stubs set in blocks of concrete, installs conduit and outlet boxes on drywalls.

ELECTRICITY

CONTENT TITLE: Drywall Installation

SUB OBJECTIVE 17: The student will demonstrate ability to install correctly flush mounted panel cans on floor and ceiling fed conduit stubs.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor cites and demonstrates requirements for setting flush mounted panel cans prior to wall erection.

A. Determine size and location of panel can and strike finished wall lines.
B. Cut and install main feeder conduit nipple to support can. Measure branch circuit feeder conduits.
C. Mark size and location of conduits (stubbed from floor and ceiling) on bottom and top of panel can.
D. Cut holes of prescribed size at designated locations in bottom and top of panel can for installation of branch-circuit feeder conduits.
E. Measure, bend and cut conduit to extend stubs to allocated openings in panel can. Use longer than normal thread lengths on rigid conduit to facilitate mounting and leveling panel can.
F. Install stub extensions.
G. Install back-up lock-nuts. Run up all the way on extra long threads.
H. Mount panel can on stub extensions.
I. Level can by adjusting back-up lock-nuts.
J. Install inside lock-nuts and bushings.
K. Flush and plumb panel can with wall line by bending straight extensions and rotating off-set extensions as required.

II. Student sets a flush mounted panel can.

ELECTRICITY

CONTENT TITLE: Drywall Installation

SUB OBJECTIVE 18: The student will demonstrate ability to prefabricate conduit and box assemblies for later installation in masonry walls.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses prefabricating conduit which is to be installed in masonry walls.

   A. Illustrate need for precision fitting of conduit to match wall dimension.
   B. Illustrate a cross-section of a masonry wall.

II. Instructor prefabricates a conduit run.

   A. Draw sketch of conduit run to match wall section detail.
   B. Make necessary bends.
   C. Check conformity of bends by placing formed conduit and outlet box over a wall section drawn full scale on the floor.
   D. Tag and identify for location of installation.

III. Student prefabricates a conduit run.

ELECTRICITY

CONTENT TITLE: Drywall Installation

SUB OBJECTIVE I9: The student will demonstrate ability to install correctly conduit and outlets.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor explains and demonstrates steps for installing conduit and outlets in dry walls.

   A. Determine location and type of outlet.
   B. Mark outlet location on wood or steel stud wall.
   C. Fasten outlet boxes to headers.
   D. Install headers between studs.
   E. Fasten outlet boxes to headers.
   F. Determine roofing and bending of outlet feeder conduit to facilitate convenient supporting of conduit.
   G. Bend and form conduit to fit designated location.
   H. Connect conduit to outlet box.
   I. Anchor conduit to supporting surfaces using National Electrical Code approved devices at approved intervals of spacing.
   J. Check protruded portion of box for flushing with surface of wallboard to be installed.

II. Student installs conduit in a drywall.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to correctly install conduit, outlets and fixtures in lath and plaster and suspended lift-out ceilings.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

Jones, E. W., and J. L. Johnston, Adequate Wiring for Home and Farm, (The Bruce Publishing Co.: Crowell Collier MacMillan Distribution Center, Front and Brown Streets, Riverside, New Jersey 08075), 1963.

National Electrical Code 1971, (National Fire Protection Association: 60 Batterymarch Street, Boston, Massachusetts 02110).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Linear measurement

Communication Skills

- Blueprint interpretation
- Working drawings
- National Electrical Code
- Materials and supply catalogs

ELECTRICITY

CONTENT TITLE: Ceiling Installation

SUB OBJECTIVE 20: The student will demonstrate ability to install correctly conduit outlets and plaster rings for a top-hat recessed light fixture in a lath-and-plaster ceiling.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing conduit, outlets and plaster rings in the ceiling.

A. Describe structure of lath-and-plaster ceilings.
B. Describe alternate methods of routing and installing conduit and outlet boxes.
C. Locate position of recessed light fixture according to National Electrical Code provisions.
D. Anchor junction box to approved support bracket.
E. Install supply conduit from junction box to point of supply.
F. Install National Electrical Code stipulated minimum of 4 feet of flexible conduit.
G. Using fixture ring as template, mark lath.
H. Cut out circular section of metal lath.
I. Fasten fixture plaster ring to lath.

II. Student installs conduit, outlets and plaster rings in the ceiling.

ELECTRICITY

CONTENT TITLE: Ceiling Installation

SUB OBJECTIVE 21: The student will demonstrate ability to hang lighting fixture in a suspended lift-out ceiling.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing conduit and lighting fixtures in suspended lift-out ceilings.

   A. Locate and mark position of lighting fixture.
   B. Locate and mark position of J-boxes.
   C. Anchor J-box to rough ceiling.
   D. Install and support conduit to J-box.
   E. Hang lighting fixture on channels of ceiling grid.
   F. Run flexible conduit from J-box to fixture.

II. Student installs lighting fixture in suspended ceilings.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to set up a hydraulic bender and to correctly operate the bender to produce one accurate 90^{0} bend and one off-set bend.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

Greenlee Bender Booklet, (Greenlee Bros. & Co.: 2136 12th Street, Rockford, Illinois 61101).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Linear measurements
- Angles and degrees

Science

- Hydraulics

Communication Skills

- Manufacturer's literature

ELECTRICITY

CONTENT TITLE: Conduit Bending

SUB OBJECTIVE 22: Given a specific conduit size, the student will demonstrate ability to assemble a hydraulic bender in the configuration which is correct for the specified pipe size.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates set-up of the hydraulic bender.

A. Position spools between support plates (position determined by size of conduit to be bent) and insert spool pins.
B. Place cylinder between support plates, insert cylinder pins and safety.
C. Attach pin shoe support to plunger and pin shoe to shoe support.
D. Connect pump hose.
E. Check pump and plunger operation.

II. Students set up a hydraulic bender.

ELECTRICITY

CONTENT TITLE: Conduit Bending

SUB OBJECTIVE 23: The student will demonstrate ability to make a 90° bend using a hydraulic bender.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor explains and demonstrates the use of the hydraulic conduit bender in making basic conduit bends.

A. Mark conduit for length of riser.
B. Subtract take-up measurement (as listed for each conduit size on bender take-up chart) and mark conduit for center of shoe position.
C. Place conduit in bender centering mark on center of shoe and position spools.
D. Operate pump until bend is slightly short of 90°.
E. Position bender with riser leg "looking up" (vertical).
F. Block lower leg in level position and, checking with a protractor, operate pump until riser leg is vertical.
G. Add one degree of bend to compensate for spring-back.
H. Release pump pressure enough to allow conduit bend to spring back.
I. Check riser for vertical.
J. If spring-back allowance was insufficient, add more bend.
K. Release pressure allowing plunger to return to "rest" position.
L. Pull spool pins and remove spools.
M. Break conduit loose from shoe by rapping conduit sharply with wood block.
N. Check bend for exact 90° configuration using framing square.
O. Measure height of riser.

II. Student makes a 90° bend in heavy conduit.

ELECTRICITY

CONTENT TITLE: Conduit Bending

SUB OBJECTIVE 24: The student will demonstrate ability to bend an off-set in rigid conduit using a hydraulic conduit bender.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates making an off-set bend.

A. Draw illustration of off-set in available space; (Full size).
B. Measure angle of bends.
C. List degrees of bends needed.
D. Mark center of each bend.
E. Measure and list distance between centers.
F. Measure and mark starting point and bend centers of off-set on conduit.
G. Make first bend using protractor level to determine correct degree of bend.
H. Level bender and conduit.
I. Make second bend, using plunger travel as reference for correct degree of bend.
J. Measure height of rise.
K. Check alignment of bends.
L. Check alignment of ends for parallel.

II. Student makes an off-set bend.

ELECTRICITY

OVERALL OBJECTIVE: The student will install, in accordance with National Electrical Code regulations and building electrical plans, the service entrance equipment, lighting equipment, cooling tower and cold storage vault for a commercial structure.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Construction Wiring, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1971.

Electrical Wiring Workbook Parts I and 3, (California State Department of Education: 721 Capitol Mall, Sacramento, California 95814), Part I - 1967, Part 3 - 1969.

Dickson, William G., ed., Electricity I, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1962.

Fisher, Electrical Trades Blueprint Reading Residential, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

Jones, E. W. and J. L. Johnston, Adequate Wiring for Home and Farm, (The Bruce Publishing Co.: Crowell Collier MacMillan Distribution Center, Front and Brown Street, Riverside, New Jersey 08075), 1963.

Mullin, Ray C., Electrical Trades Blueprint Reading and Sketching Residential, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

National Electrical Code 1971, (National Fire Protection Association: 60 Batterymarch Street, Boston, Massachusetts 02110).

Rigid "200" Portable Power Drive (Ridge Tool Co.: Elyria, Ohio 44035), Form 4-03, 1955.

Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will install, in accordance with National Electrical Code regulations and building electrical plans, the service entrance equipment, lighting equipment, cooling tower and cold storage vault for a commercial structure. (Continued)

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Scale measurement
- Equipment and material sizing
- Linear measurement

Science

- Current
- Transformer
- Meters
- Fuses and circuit breakers
- Circuitry
- Specialty switches
- Starting amperage and running amperage of motors

Communication Skills

- Blueprint interpretation
- Manufacturer's literature
- Electrical symbols
- National Electrical Code
- Related safety
- Schematic interpretation

ELECTRICITY

CONTENT TITLE: Equipment Installation

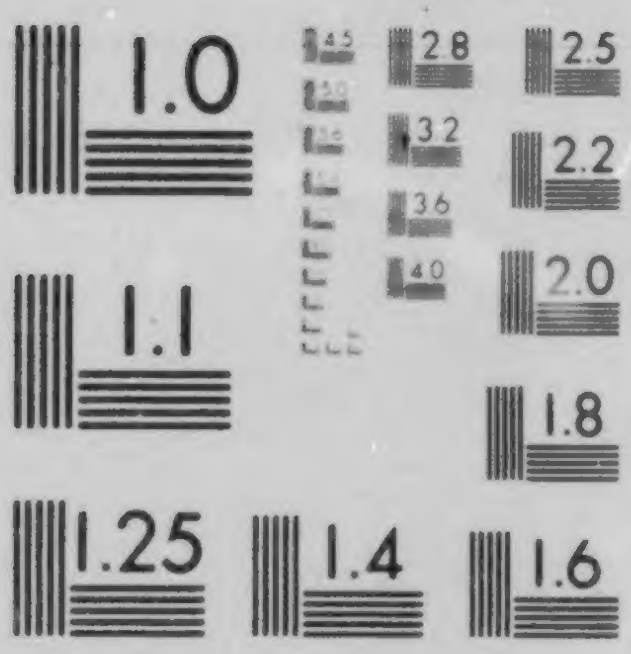
SUB OBJECTIVE 25: The student will demonstrate ability to mount service entrance equipment and install conduit.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates or discusses mounting of service equipment and installation of conduit.

   A. Determine size and type of equipment from riser diagrams.
   B. Determine location of equipment from electrical floor plan.
   C. Measure and mark location of equipment.
   D. Mount current transformer can.
   E. Mount meter cabinet.
   F. Mount main disconnect switch.
   G. Mount distribution panel.
   H. Determine conduit size from riser diagram.
   I. Install and support service entrance conduit.

II. Student installs service entrance equipment.



MICROCOPY RESOLUTION TEST CHART

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ELECTRICITY

CONTENT TITLE: Rigid Metal Conduit

SUB OBJECTIVE 26: The student will demonstrate ability to operate a power-operated pipe threading machine.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates operating a power threading machine.

A. Select required dies and matching tail stock.
B. Mount dies (in correct sequence) in stock.
C. Mount stock on pipe, and center with set screws, setting pipe to center of tail stock and with dies just touching forward end of pipe. Tighten set screws.
D. Erect power vise and connect to cutting mechanism with universal shaft.
E. Bump motor to ensure that threading will start correctly.
F. Start power vise, liberally lubricating cutting dies as threading progresses.
G. Disassemble and clean at close of cutting operation.

II. Student threads a large pipe using a power threader.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 27: The student will demonstrate ability to install wire and connect the service entrance equipment.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses connecting service entrance equipment.

A. Measure and cut wires to correct length.
B. Identify line and load terminals on transformers.
C. Form wires in equipment cabinets.
D. Determine correct terminals to connect wires.
E. Correctly identify wire phases by color code.

II. Instructor demonstrates installing wire and connecting service entrance equipment.

A. Measure and list size, number and length of wires for each run.
B. Measure, cut and mark wires for phase identification.
C. Pull wire into conduit, leaving tails of adequate length in each cabinet.
D. Identify wires and their related terminals.
E. Form wires in cabinet.
F. Cut wire-tails to correct length.
G. Connect wire to terminals.
H. Install and connect system ground.
I. Install weather head.

III. Student installs wire and connects service entrance equipment.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 28: The student will demonstrate ability to install correctly the sub-feeder from a distribution panel through a crawl space to the branch circuit panel.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses sub-feeders as an integral part of the electrical system.

   A. Cite National Electrical Code provisions for installing sub-feeders.
   B. Demonstrate method of determining size of wire and conduit required for sub-feeder.
   C. Determine most economical route for installing sub-feeders.
   D. Prepare and run conduit from main distribution panel to branch circuit panel.
   E. Suspend conduit using concrete inserts, threaded rod and cuff-type conduit hangers.
   F. Determine size, number and length of wire needed.
   G. Measure and cut wire to predetermined length and pull into conduit.
   H. Determine location of circuit breakers or fuses delegated to protect branch circuit panel.
   I. Form and connect feeder wires.
   J. Form and connect sub-feeders to main feed lugs in branch circuit panel.

II. Student installs sub-feeder equipment.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 29: The student will demonstrate ability to install correctly the branch circuit wiring in the conduit system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing branch circuit wiring.

A. Describe requirements for circuiting convenience outlets, light outlets and special purpose outlets as stipulated by National Electrical Code and local ordinances.

B. Illustrate methods of determining number and size of wires to be pulled into each conduit run.

C. Set up wire reels or wire cartons in location so that several runs may be pulled without moving set-up.

D. Insert fish tape and pull required number of wires in each run.

E. Pull home run feeders into branch circuit panel and tag each hot feeder, identifying it for the type and location of the outlets it supplies.

F. Make joints in outlet boxes as required.

II. Student installs branch circuits.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 30: The student will demonstrate ability to install correctly the branch circuit panel interior, circuit breakers and branch circuit conductors.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installation of branch circuit panel interiors, circuit breakers and circuit contractors.

   A. Install branch circuit panel interior.
   B. Install circuit breakers as specified in circuit arrangement drawing by counting breaker mounting spaces.
   C. Form conductors and connect to breakers as shown on circuit lay out sheets (conductors identified by tags attached in previous assignment).
   D. Install panel cover.
   E. List type and location of outlets beside breaker number on panel index card.

II. Student installs branch circuit panel interior, circuit breakers and circuit conductors.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 3I: The student will demonstrate ability to install and connect lighting fixtures.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses standards of quality required in light fixture installation.

   A. Discuss types of fixtures and various suspension and mounting methods.
   B. Cite code requirements for installation and wiring of recessed fixtures.
   C. Cite code requirements for wire insulation on ballasts of fluorescent fixtures.

II. Instructor demonstrates installing a variety of lighting fixtures.

   A. Hang lamp, connect and reassemble a surface mounted and a recessed fluorescent fixture.
   B. Hang, connect lamp and reinstall a vapor-proofed, recessed and surface-mounted incandescent fixture.
   C. Hang, connect lamp and reassemble incandescent, fluorescent, mercury vapor or quartz flood lamps in wall-mounted or standard (pole) mounted configurations.

III. Students install a variety of lighting fixtures.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 32: The student will demonstrate ability to install conduit and underground wiring for a cooling tower.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses aspects of cooling tower installation.

A. Illustrate conventional locations for towers and pumps.
B. Discuss methods of identifying pumps.
C. Warn of possible damage caused by running pumps without water.
D. Describe motor starting overload protection equipment.
E. Describe voltage, phase and current requirements of conventional pump.
F. Describe use of float operated switch for controlling pump motors.
G. Draw conduit layout for typical tower with pump installed at ground elevation.
H. Cite code requirements for installing conduit and wire below wire.
I. Determine voltage, phase and current requirements for specific pump motor, from motor's data plate.
J. Determine wire size from table in National Electrical Code (allowing 125% for motor loads).
K. Determine number of wires (motor feed circuit plus control circuit) required at tower (from schematic wiring diagram).
L. Determine conduit size using table in National Electrical Code.
M. Determine conduit type required for specific conditions of use (National Electrical Code and local ordinance).
N. Determine size of motor starter required (Use horsepower rating of motor).

Continued...

ELECTRICITY

CONTENT TITLE: Equipment Installation (Continued)

SUB OBJECTIVE 32: The student will demonstrate ability to install conduit and underground wiring for a cooling tower.

SUGGESTED ACTIVITIES: (Students and Teachers)

II. Instructor demonstrates installation of a cooling tower conduit and wiring.

A. Nipple motor starter to power panel.
B. Route, form and install conduit on interior of building.
C. Exit conduit through outside wall, using applicable conduit fittings.
D. Form and install conduit in trench outside of building.
E. Apply protective coating to conduit.
F. Install weatherproof flexible conduit from "T" conduit to motor junction box.
G. Install weatherproof flexible conduit from "T" conduit to float-switch junction box.

III. Student installs conduit system underground to a cooling tower.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 33: The student will demonstrate ability to install the wiring and connect a pump motor and related controls in a cooling tower.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor diagrams the circuitry.

A. Diagram motor feed circuit.
B. Diagram motor control circuit.

II. Instructor demonstrates installing wiring and controls for cooling tower.

A. Select wire colors of sufficient variety to assure easy identification.
B. Pull wire through conduit allowing sufficient length for connecting.
C. Identify line, load and control wiring terminals on motor starting relay.
D. Connect feed wires to line terminals (L).
E. Connect motor wires to load (T) terminals.
F. Connect float-switch wires to control terminals.
G. Connect motor feed wires to motor leads. Check dual voltage motors for correct internal connections.
H. Connect control wires to float-switch.
I. Connect motor feed circuit to assigned breakers in power panel.
J. Determine correct direction of rotation pump.
K. Momentarily start, or "bump" motor to ascertain correct rotation.

III. Student installs wiring and connects pump in a cooling tower.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 34: The student will demonstrate ability to install and connect the wiring in a cold storage vault.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor describes the equipment found in a typical cold storage vault and its installation.

II. Instructor demonstrates installation of equipment in a cold storage vault.

- A. Draw schematic wiring diagram.
- B. Sketch vault to indicate equipment locations.
- C. Note conduit size, number and size of wires.
- D. Install conduit from outside J-box to cross conduit inside.
- E. Install conduit and pull wire from cross-conduit to thermostat, lights, second cross-conduits, evaporator fan motor, liquid solenoid valve and defroster heater and timer unit.
- F. Using the schematic, connect all wiring.

III. Student installs ~~a~~ cold storage vault.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to safely and effectively move heavy materials laterally with pipe rollers and vertically by the cribbing method.

SOURCES OF INFORMATION

Rossnagel, W. E., Handbook of Rigging, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1964.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Addition
- Subtraction
- Multiplication
- Division
- Whole numbers
- Fractions
- Decimals

Science

- Simple machines
- Hydraulic jacks
- Center of gravity
- Inertia
- Friction

Communication Skills

- Manufacturer's literature
- Blueprint interpretation
- Engineering specs
- Student Resource Manual
- Related safety

ELECTRICITY

CONTENT TITLE: Move Heavy Equipment

SUB OBJECTIVE 35: The student will demonstrate ability to raise safely a distribution panel to a concrete mounting pad using the cribbing method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the cribbing method of raising a heavy load.

A. Discuss safety considerations.
B. Raise end of skid mounted pad and place 2 x 4's cross-ways under end, using a hydraulic jack.
C. Raise opposite end and repeat process.
D. Raise one side of pad placing 2 x 4's under skid longitudinally.
E. Repeat process on opposite side.
F. Continue raising and placing criss-crossed cribbing until load reaches the desired height (last crib timbers should be parallel with skids).
G. Position rollers and move load onto concrete pad.
H. Center anchor holes over anchor bolts (set in concrete) and lower load.

II. Student uses cribbing method to raise a heavy load.

ELECTRICITY

CONTENT TITLE: Move Heavy Equipment

SUB OBJECTIVE 36: The student will demonstrate ability to move safely a skid mounted electrical distribution panel laterally using pipe rollers and coffin hoists.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates load moving with pipe rollers and a coffin hoist.

   A. Raise front end of load using shop mule or crow bar and block fulcrum.
   B. Insert pipe roller.
   C. Raise opposite end, inserting second roller under skids slightly to the rear of center.
   D. Place third roller in front of load and on floor, 18" from first roller (catch-up roller).
   E. Attach coffin hoist and operate hoist to move load.
   F. Feed new rollers under load at intervals as necessary.

II. Student moves a heavy load using pipe rollers and a coffin hoist.

INDUSTRIAL WIRING

114

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to identify, test and connect components of a power supply distribution system and to hook up power supply distribution transformers for 115V ac, 115 and 230V ac, 3-phase (Y configuration), 3-phase (Δ configuration and 3-phase (4 wire, Δ configuration).

SOURCES OF INFORMATION

Electrical Wiring Workbook Parts 1 and 3, (California State Department of Education: 721 Capitol Mall, Sacramento, California 95814), Part 1 - 1967, Part 3 - 1969.

Fisher, Electrical Trades Blueprint Reading Industrial, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

Gerrish, Howard H., Exploring Electronics, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1971.

Gerrish, Howard H., Learning Experiences in Electricity, (Buck Engineering Co.: State Highway 34, Farmingdale, New Jersey 07727), 1967.

Lister, Eugene C., Electrical Circuits and Machines, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1968.

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Bureau of Naval Personnel, Construction Electrician 1 & C, NAVPERS 10637-D, (Order from GPO, Document No. D208.11:E12/8/970), 1970.

Valkenburgh, Van, Basic Electricity, (John F. Rider Publishers, Inc.: 116 West 14th Street, New York, New York 10011), 1954.

Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to identify, test and connect components of a power supply distribution system and to hook up power supply distribution transformers for 115V ac, 115 and 230V ac, 3-phase (Y configuration), 3-phase (Δ configuration and 3-phase (4 wire, Δ configuration). (Continued)

SOURCES OF INFORMATION

Wildi, Theodore and Michael J. DeVito, Investigations in Electric Power Technology, (Buck Engineering Co.: State Highway 34, Farmingdale, New Jersey 07727), 1971.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Meter scale interpolations

Science

- Transformer theory
- High voltage systems
  - Conductors
  - Insulators
  - Fusing devices
- Single phase and three phase system

Communication Skills

- Schematic drawings
- Manufacturer's literature
- National Electrical Code
- Related safety
  - Handling and checking high voltage components

ELECTRICITY

CONTENT TITLE: Transformers and Related Power Supply Distribution Systems

SUB OBJECTIVE I: The student will demonstrate ability to identify types and uses of power supply transformers.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor describes and discusses transformer applications.

A. Power supply applications include transmission power transformers (pots), distribution transformers, voltage regulation transformers and control transformers.
B. Show slides of switch yards and sub-stations to identify power transformers.
C. List transmission voltages and primary distribution voltages (pointing out the difference in insulating problems).
D. Illustrate construction and cooling methods.
E. Show slides of distribution transformers on poles, pads and in vaults.
F. List primary and secondary distribution voltages.
G. Stress difference in insulating problems.
H. Explain difference in wire size required.
I. Identify and explain purpose of hardware components such as arm insulators, high voltage fused cut-outs, lighting arrestors, grounding, hot line clamps and line baskets.
J. Show slides and describe purpose of voltage regulation transformers.
K. Identify control transformers on display board.
L. Describe job applications of control transformers.
M. Describe construction and mounting methods.
N. List input and output voltage combinations.

II. Students describe and discuss transformer applications.

ELECTRICITY

CONTENT TITLE: Transformers

SUB OBJECTIVE 2: The student will demonstrate ability to describe theory of operation and connect control transformers.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor describes the theory of transformer operation and demonstrates connecting control transformers.

A. Diagram and explain the purpose of the transformer core, the primary coil and the secondary coil.
B. Display and identify parts of a transformer.
C. Explain and illustrate the relation of voltage change ratio to ampere-turns ratio.
D. Measure voltage in primary coil of a solder-gun and compare with output voltage of secondary coil or turn.
E. Measure amperes in primary circuit and compare to amperes in secondary circuit.
F. Multiply secondary amperes times number of visible secondary coil turns to obtain the value of the ampere-turns in the secondary coil.
G. Compute number of turns in primary coil by using the known ampere-turns in the secondary coil with the known voltage step down ratio and the known current in the primary coil.
H. Compute power loss (in watts) by subtracting the wattage (EXI) in the secondary coil from the wattage in the primary coil.
I. Diagram transformer coils and explain transfer of electrical energy through magnetic coupling (electro-magnetic induction).
J. Explain why induction can take place only when primary is supplied with alternating or pulsating (changing magnetic field) current. Explain counter-EMF (inductive reactance) and diagram transformer with center-tapped, secondary coil. Relate number of turns in each coil to output voltage.

Continued...

ELECTRICITY

CONTENT TITLE: Transformers (Continued)

SUB OBJECTIVE 2: The student will demonstrate ability to describe theory of operation and connect control transformers.

SUGGESTED ACTIVITIES: (Students and Teachers)

K. Using tri-tap (115 to 8-16-24 volt) transformer, measure output voltages between taps.

L. Diagram secondary coil connections showing sample number of turns between taps in proper turn to voltage ratios.

M. Demonstrate connecting 8 volt buzzer to correct taps.

N. Demonstrate connecting 16 volt door chimes to correct taps.

O. Demonstrate connecting 440 volt to 115/230 volt industrial control transformer. Do this by:
   1) Identify high-side H1 and H2 leads.
   2) Identify low-side X1, X2, X3 and X4 leads.
   3) Connect secondary in series and measure 230V.
   4) Connect secondary in parallel and measure 115 volts. (Warn of danger from incorrect connections.)

II. Students describe the theory of transformer operation and connect control transformers.

ELECTRICITY

CONTENT TITLE: Insulation Testing

SUB OBJECTIVE 3: The student will demonstrate ability to test insulation for its dielectric strength.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates testing insulation for its dielectric strength.

   A. Describe need for testing insulation before energizing equipment and distribution systems, transformers, large motors, underground cables and generators.
   B. Describe and display insulation testers, such as meggers, vibro-tests, hi-pot and E.T.C.
   C. Warn of dangerous voltages produced.
   D. Explain allowable leakage at different voltages and explain possible causes of current leakage.
   E. Describe and illustrate methods of "drying out" systems showing excessive leakage such as applying heat by using external heat strips and lamps or by applying excessive current at a minimum voltage.

II. Instructor demonstrates use of testers.

   A. Connect tester to distribution transformer primary coil (using pot with water added to oil to induce leakage).
   B. Connect tester to transformer with clean oil and good insulation.
   C. Explain difference in readings.
   D. Test a number of old motors. Brand them as "usable-as-is," or "unusable".

III. Students test insulation for dielectric strength.

ELECTRICITY

CONTENT TITLE: Transformers

SUB OBJECTIVE 4: The student will demonstrate ability to diagram and connect power-supply distribution transformers.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses parts of distribution transformer (with cut-away side, exposing all internal parts), their function, connection and operation.

   A. Describe primary distribution voltages (line-to-ground and line-to-line).
   B. Interpret data plate information.
      1. Discuss applications requiring Wye (Y) and Delta (Δ) connections (line-to-ground and line-to-line).
      2. Discuss secondary internal connection changes for Wye and Delta connections (series and parallel connection of secondary coils).
      3. Discuss volt-ampere method of power rating.

II. Instructor demonstrates connecting a transformer for single phase, 115V supply.

   A. Open cut-outs with hot-stick.
   B. Connect primary for related voltage.
   C. Connect secondaries in parallel (internally) to provide full KVA capacity.
   D. Connect external wiring to fused safety switch to supply power at 115V.
   E. Install fuse in high-voltage cutout.
   F. Close high voltage cutout.
   G. Measure voltage at fused safety switch (115 volts).

III. Students connect a transformer for single phase, 115V supply.

ELECTRICITY

CONTENT TITLE: Transformers

SUB OBJECTIVE 5: The student will demonstrate ability to diagram and connect power supply distribution transformers to supply 115 and 230 volts.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor diagrams and connects power supply distribution transformers to supply 115 and 230 volts.

   A. Demonstrate connecting transformers to supply power at 115 and 230 volts.
   B. Connect secondary in series (internally).
   C. Diagram and connect secondary bushings to line side of 2 fuse, solid neutral switch.
   D. Connect secondary center bushing to neutral bar at switch.
   E. Throw in cutouts.
   F. Measure voltage from line-to-line at 230 volts.
   G. Measure voltage from L-1-to-neutral and L-2-to-neutral at 115 volts.
   H. Relate voltage readings of distribution transformers to those obtained from similar split-secondary control transformer.

II. Students diagram and connect transformers for 115 and 230 volt operation.

ELECTRICITY

CONTENT TITLE: Transformers

SUB OBJECTIVE 6: The student will demonstrate ability to diagram and connect power supply distribution transformers to supply 3-phase power, Δ configuration.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates connecting transformers in the 3-wire "Delta" configuration.

   A. Series secondary coils.
   B. Install external wiring to 3-fuse safety switch (use orange wire for L-3).
   C. Measure and list voltage readings, from line-to-line at safety switch.

II. Students connect transformers in 3-wire Δ configuration.

ELECTRICITY

CONTENT TITLE: Transformers

SUB OBJECTIVE 7: The student will demonstrate ability to diagram and connect power-supply distribution transformers to supply 3-phase power, Y configuration.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses 3-phase power and demonstrates hooking up distribution transformers (Y-connections) to supply 3-phase power.

   A. Discuss advantages and applications of 3-phase power.
   B. Diagram 3-phase distribution transformers. Illustrate Y and Δ connections and discuss the characteristics, advantages, and disadvantages of these types of hookup.
   C. Diagram external wiring from transformers to 3 fuse solid neutral safety switch for Y connection.
   D. Connect wiring (Y) and close cutout.
   E. Measure and list voltage readings from each line to each line and from each line to neutral.

II. Students hook up distribution transformers (Y connection) to supply 3-phase power.

ELECTRICITY

CONTENT TITLE: Transformers

SUB OBJECTIVE 8: The student will demonstrate ability to diagram and connect power supply distribution transformers to supply 3-phase power, 4 wire Δ connection.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates making the 4-wire delta connection. (Power switch still connected from previous assignment.)

   A. Install external wiring to 2 fuse lighting switch (using lines 1, 2 and neutral).
   B. Measure and list voltage readings in 2 fuse switch.
   C. Measure and list voltage reading from line 3 in power switch to neutral in light switch.
   D. Explain why L-3 and neutral can never be installed in the same supply switch (NEC ruling).
   E. Stress danger of working L-3 (high-leg) with wet shoes (190V to ground).
   F. Explain use of orange wire for L-3 identification.

II. Students make the 4-wire delta connection.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to test operate, diagnose and correct malfunctions in motor control systems such as emergency standby power systems, motor generator sets, dc substations, etc.

SOURCES OF INFORMATION

Gerrish, Howard, Learning Experiences in Electricity, (Buck Engineering Co.: State Highway 34, Farmingdale, New Jersey 07727).

Suffern, Maurice Grayle, Basic Electrical and Electronic Principles, (McGraw-Hill Book Co.: 1221 Avenue of the Americas, New York, New York 10020), 1962.

Van Valkenburgh, Basic Electricity, (John F. Rider Publishers, Inc.: 116 West 14th Street, New York, New York 10011), 1954.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Capacitors
- Potentiometers
- Rectifiers
- DC and AC theory
- Electric motor systems
- Generators
- Oscilloscope operation

Communication Skills

- Vocabulary development
- Manufacturer's literature
- Related safety
  - Checking electrical systems and components

ELECTRICITY

CONTENT TITLE: Capacitors

SUB OBJECTIVE 9: The student will demonstrate ability to identify types, uses and characteristics of capacitors.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses capacitors and their testing.

A. Describe types and applications of capacitors. Include application descriptions and demonstrations for use in motors, arc prevention devices, time delay circuits and filtration devices.

B. Diagram and explain characteristics of capacitors in direct current and alternating current circuits, as dc check valves.

C. Diagram, explain and demonstrate characteristics of capacitors used as electrical charge storing devices.

D. Stress caution in handling charge capacitors.

E. Diagram, explain and demonstrate characteristics of capacitors used as phase shifters or current leading devices.

F. Connect running capacitor across power line. Demonstrate effect known as watt-less power and note effect on voltage and current relation. Connect inductive type ammeter to line and note current flow. Connect a wattmeter to line and note that no power is being used.

G. Explain wattless power.

H. Describe and illustrate Farad rating system for capacitors.

I. Explain ac and dc voltage rating.

J. Demonstrate testing capacitors with an ohmmeter.

II. Students identify types, uses and characteristics of capacitors.

ELECTRICITY

CONTENT TITLE: Voltage Regulators

SUB OBJECTIVE 10: The student will demonstrate ability to identify types and uses of potentiometers (voltage dividers).

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses types and applications of voltage dividers.

   A. Identify types.
   B. Diagram circuits incorporating voltage dividers.

II. Instructor demonstrates operation of voltage dividers.

   A. Connect voltage divider to a circuit.
   B. Connect voltmeter and note voltage change as control knob is rotated from one stop to another.
   C. Identify voltage dividers by voltage and current ratings.

III. Students identify types and uses of potentiometers.

ELECTRICITY

CONTENT TITLE: Rectifiers

SUB OBJECTIVE II: The student will demonstrate ability to identify types and uses of rectifiers.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses rectifiers.

A. Discuss applications of rectifiers such as used in battery charges (for emergency power stations), welding machines, power supplies for dc motors, and in power supplies for the reduction of aluminum ore.

B. Discuss types of rectifiers, such as dry plate selenium, semiconductor diodes, vacuum tube and mercury arc types.

II. Instructor demonstrates operation of rectifiers.

A. Diagram and trace current flow through a half wave rectified circuit.

B. Illustrate wave form of half wave rectified current on an oscilloscope.

C. Diagram and trace current flow through a full wave rectified circuit.

D. Illustrate wave form of full wave rectified current on an oscilloscope.

E. Demonstrate testing rectifiers for reverse current leakage. Demonstrate using oscilloscope method, test light and capacitor in series method and ohmmeter method.

III. Students identify types and applications of rectifiers and test their reverse current leakage.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to install, connect, test, operate and correct malfunctions in explosion proof and bus duct wiring systems.

SOURCES OF INFORMATION

Electrical Wiring Workbook Parts I and 3, (California State Department of Education: 721 Capitol Mall, Sacramento, California 95814), Part I - 1967, Part 3 - 1969.

Fisher, Electrical Trades Blueprint Reading Industrial (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York), 1969.

National Electrical Code 1972, (National Fire Protection Association: 60 Batterymarch Street, Boston, Massachusetts 02110), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Science

Explosion proof electrical systems

Communication Skills

- Manufacturer's literature
- National Electrical Code

ELECTRICITY

CONTENT TITLE: Bus Duct Systems

SUB OBJECTIVE I2: The student will demonstrate ability to install a bus duct system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses bus duct systems.

A. Discuss types of jobs utilizing bus duct such as machine shops, welding ships, metal and wood fabricating mills, etc.
B. List advantages of bus duct systems such as versatility, compactness, etc.
C. Display and discuss components of bus duct systems.

II. Demonstrate installing bus duct systems.

A. Assemble bus duct section.
B. Mount on wall of shop.
C. Connect conduit from bus duct junction box to power distribution panel.
D. Couple second section of bus duct to first section.
E. Install dead end plate.
F. Pull wire from main power panel to bus duct junction box.
G. Connect wire to bus lugs.
H. Connect wire to power panel breakers.
I. Select bus duct switch opening nearest machine to be connected.
J. Install bus duct switch of proper ampacity.
K. Install conduit and wire to machine.
L. Fuse bus duct switch.
M. Close breakers and switch.
N. Test run machine.
O. Correct malfunctions.

III. Students install a bus duct system.

ELECTRICITY

CONTENT TITLE: Explosion Proof Wiring Systems

SUB OBJECTIVE 13: The student will demonstrate ability to identify the need for and install explosion proof wiring systems.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses explosion proof wiring.

- A. Interpret N.E.C. definition of class I hazardous locations.
- B. Translate wiring requirements for such locations.
- C. List types of jobs that would fall in this category.
- D. Draw plan layout of typical small job.
- E. Illustrate explosion-proof type light fixtures, plugs, switches and motor.
- F. Describe requirements of explosion proof fittings.
- G. Disassemble fittings pointing out characteristics that qualify them as being explosion proof.
- H. Identify and explain function of seal-off fittings.

II. Instructor demonstrates installing an explosion proof system.

- A. Make conduit layout for all outlet locations.
- B. Install outlets connected with rigid conduit.
- C. Connect motor using explosion-proof flexible coupling and explosion-proof union.
- D. Demonstrate packing and sealing seal-off fittings.
- E. Test operation of circuits.
- F. Correct malfunctions.

III. Students install an explosion proof system.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to identify, connect, test, operate, detect malfunctions in and correct defects in the operation of line voltage, time delay, potential motor starting, current motor starting, overload protection and overload protection motor starting relays.

SOURCES OF INFORMATION

Allen-Bradley, Industrial Control Catalog, No. 101, (1201 South Second Street, Milwaukee, Wisconsin 53204).

Alerich, Walter N., Electrical Motor Controls, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York).

Gerrish, Howard H., Exploring Electronics, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1971.

Bureau of Naval Personnel, Construction Electrician I & C, NAVPERS 10637-D, (Order from GPO, Document No. D208.11:E12/8/970), 1970.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Relay theory and operation
- Overload switching devices

Communication Skills

- Manufacturer's literature
- Related safety
  - Installing and checking relays and other electrical components

ELECTRICITY

CONTENT TITLE: Relays

SUB OBJECTIVE 14: The student will demonstrate ability to identify the basic parts and adjust a relay.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses relays and their operation.

A. Discuss operating principles of relays.
B. Demonstrate different types; e.g., spring operated, gravity types, etc.
C. Discuss terms core-gap and contact clearance. Demonstrate adjusting these parameters and the consequent failures brought about by improper adjustment.

II. Students identify and adjust relays.

ELECTRICITY

CONTENT TITLE: Line Voltage Relays

SUB OBJECTIVE 15: The student will demonstrate ability to identify and connect line voltage relays.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses line voltage relays and installs simple circuits.

   A. Describe and illustrate various jobs in which multiple contact, line voltage relays may be used.
   B. Display various types of relays containing normally open and normally closed contacts.
   C. Diagram relays to show coil terminals, voltage contact arrangements and configurations.
   D. Demonstrate method of determining configuration of each contact using battery powered test light.
   E. Describe and illustrate hypothetical job requiring alternate operation of various circuits.
   F. Diagram circuits controlled by normally open and normally closed relay contacts.
   G. Connect circuits to relay on display board.
   H. Demonstrate operation of circuits.

II. Students install line voltage relays.

ELECTRICITY

CONTENT TITLE: Time Delay Relays

SUB OBJECTIVE I6: The student will demonstrate ability to identify and connect time delay relays.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and installs a sample time delay relay installation.

   A. Describe and illustrate jobs requiring delayed action of control contacts opening or closing such as increment step started motors, momentary voltage dip, etc.
   B. Display time delay type relay explaining and illustrating its mechanical construction and operation.
   C. Identify relay's contact arrangement and configuration.
   D. Describe job requiring the use of timed action relay.
   E. Diagram circuits to meet job requirements.
   F. Connect relay and circuits.
   G. Test operate relay and circuits for compliance with job requirements.
   H. Demonstrate method of setting time delay.
   I. Check time delay using stop watch or cycle counter.

II. Students identify and connect a time delay relay installation.

ELECTRICITY

CONTENT TITLE: Motor Starting Relays

SUB OBJECTIVE I7: The student will demonstrate ability to identify and connect potential type motor starting relays.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and installs a sample motor starting relay installation.

   A. Describe and list applications of potential type relays as used for starting multihorsepower, single-phase motors (air conditioning compressors, radial arm saws, well pumps, etc.)
   B. Describe generator action of start winding as motor approaches synchronous speed.
   C. Demonstrate "closing voltage" of relay using variable power supply and voltmeter.
   D. Install and connect relay in motor box.
   E. Demonstrate start winding's ability to generate power by measuring voltage generated by start winding while motor is running at synchronous speed.
   F. Explain and demonstrate checking of "dwell-time" (relay dwells or holds motor in start until near synchronous speed is attained).

II. Students identify and connect potential motor starting relays.

ELECTRICITY

CONTENT TITLE: Motor Starting Relays

SUB OBJECTIVE 18: The student will identify and connect current type motor starting relays.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor identifies and connects current-type motor starting relays.

   A. Describe use of current-type relays.
   B. Explain the characteristics of current relays as opposed to potential and line voltage relays.
   C. Diagram connecting current relays in series with the motor's start winding.
   D. Display cutaway relay showing heavy gauge of relay coil winding.
   E. Demonstrate method of determining selection of correct relay for a specific motor.
   F. Install and connect relay to motor.
   G. Check dwell-time of relay using inductive ammeter.

II. Student identifies and connects current-type motor starting relays.

ELECTRICITY

CONTENT TITLE: Motor Starting Overload Protector Relays

SUB OBJECTIVE 19: The student will demonstrate ability to identify and connect overload protection motor starting relays.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor identifies and connects overload protection motor starting relays.

A. Describe job applications of overload relay.
B. List various sizes and types.
C. Diagram typical relays, showing feed circuit contacts, auxiliary switch, overload switch, overload heater coils and magnetic coil.
D. Explain functions of various parts in various makes.
E. Describe and illustrate "melt-out" type thermal overload switch.
F. Describe and illustrate bi-metal "warp-out" type overloads.
G. Describe and illustrate concave-disc "pop-out" overloads.
H. Describe and illustrate magnetic overloads.
I. Demonstrate use of motor-starter chart in selecting correct heater coils for a specified motor.
J. Demonstrate operation of overload switch.
K. Explain effect of circuit short in motor circuit.
L. Demonstrate resetting overload switch.
M. Using diagram in cover of motor starter, connect starter to motor and controls relay using single pole switch.
N. Operate motor by manually closing relay, then by magnetically closing relay, thereby demonstrating the function of each circuit.

II. Students identify and connect overload protection motor starting relays.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to identify by type and application basic motor types and their components. In addition, student will connect, test, troubleshoot and correct defects in single-phase dual-voltage, three-phase single-voltage, three-phase dual-voltage and three-phase two speed motors.

SOURCES OF INFORMATION

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Continued...

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to identify by type and application basic motor types and their components. In addition, student will connect, test, troubleshoot and correct defects in single-phase dual-voltage, three-phase single-voltage, three-phase dual-voltage and three-phase two speed motors. (Continued)

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Rosenberg, Robert, Electric Motor Repair, (Holt, Rinehart & Winston Inc.: 383 Madison Avenue, New York, New York 10017), 1960.

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Timbie, William H. and Arthur L. Pike, Essentials of Electricity, (John Wiley & Sons, Inc.: 605 Third Avenue, New York, New York 10016), 1963.

Wildi, Theodore and Michael J. DeVito, Investigations in Electric Power Technology, (Buck Engineering Co.: State Highway 34, Farmingdale, New Jersey 07727), 1971.

ACADEMIC RELATED THEORY AND INFORMATION

Math

Electrical measurements
- Horsepower
- RPM
- Start and running
- Amperage

Science

. Various electrical motors
- Theory
- Components

Communication Skills

. Manufacturer's literature

. Vocabulary development

. Related safety - working with electric motors

. Schematic drawing interpretation

ELECTRICITY

CONTENT TITLE: Electric Motors

SUB OBJECTIVE 20: The student will demonstrate ability to identify types of motors.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses types of motors.

A. Describe applications.

B. Explain motor classifications and characteristics such as duty factor, temperature rise, starting torque, high and low inertia and housing type.

C. Display and identify various types of motors describing their characteristics and methods of identification. Include shaded pole induction (squirrel cage), split phase induction, capacitor start, induction-repulsion, ac-dc universal, three-phase induction, three-phase induction wound rotor and three-phase synchronous with separately excited field.

II. Students identify types of motors.

ELECTRICITY

CONTENT TITLE: Electric Motors

SUB OBJECTIVE 21: The student will demonstrate ability to identify the basic parts of motors.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor identifies parts of motors.

A. Disassemble shaded pole motor. While doing so, explain function of the starter, rotor, shaft, end bells and bearings. When reassembling, explain sequence and check points to observe.

B. Repeat demonstration with split-phase motor including explanation of centrifugal starting switch, capacitor and internal thermal overload protector.

C. Repeat demonstration using ac-dc universal motor, explaining function of brushes, commutator and wound rotor.

D. Repeat demonstration using induction-repulsion motor, pointing out brushes, commutator and wound rotor.

II. Students identify parts of motors.

ELECTRICITY

CONTENT TITLE: Single Pole Single Voltage Electric Motor

SUB OBJECTIVE 22: The student will demonstrate ability to connect a single phase, single voltage, split phase motor for clockwise and counter-clockwise rotation and determine possible causes of malfunctions.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates connecting a single phase, single voltage motor.

   A. Interpret information listed on motor's data plate, such as horsepower, voltage, current, phases and RPM.
   B. Diagram external wiring connection from motor's connecting diagram.
   C. Identify and diagram motor's internal wiring by measuring resistance of start and run windings.
   D. Explain function of each winding.
   E. Connect motor to lines supplying correct voltage.
   F. Test run, noting direction of rotation.
   G. Reconnect motor for opposite direction at rotation by interchanging the start winding leads.
   H. Demonstrate reaction of motor with open run circuit.

II. Students connect a single phase, single voltage motor.

ELECTRICITY

CONTENT TITLE: Single Phase Dual Voltage Electric Motors

SUB OBJECTIVE 23: The student will demonstrate ability to connect a single phase, dual voltage motor for high and low voltage and reverse rotation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates connecting single phase, dual voltage motors for high and low voltage and reverse rotation service.

A. Describe advantages of dual voltage motors.
B. Illustrate relation of voltage rating to corresponding ampere rating on data plate.
C. Diagram motor's internal wiring with information gained by tracing with ohmmeter.
D. Diagram low voltage connection of motor from motor's connecting diagram.
E. Illustrate parallel connection of coils.
F. Diagram high voltage connection of motor.
G. Illustrate series connection of run windings and parallel connection of start winding.
H. Connect motor for low voltage and check current consumption, using inductive type ammeter.
I. Connect motor for high voltage and check current consumption.
J. Reconnect motor for opposite direction of rotation.
K. Stress importance of learning the sounds of a correctly operating motor.

II. Students connect single phase, dual voltage motor for high and low voltage and reverse rotation service.

ELECTRICITY

CONTENT TITLE: Three Phase Single Voltage Electric Motors

SUB OBJECTIVE 24: The student will demonstrate ability to connect a 3-phase, single voltage motor for clockwise and counter-clockwise rotation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates connecting 3-phase single voltage motors for clockwise and counter-clockwise rotation.

   A. Describe advantages of 3-phase motors over single phase in current requirements, available horsepower, initial wiring costs and maintenance expense.
   B. Diagram star connected motor.
   C. Trace current flow through coils, timed with sine wave illustration of 3-phase currents.
   D. Describe relation of rotation to phase sequence.
   E. Connect and test run motor, noting direction of rotation.
   F. Check phase sequence of power supply, using phase sequence meter.
   G. Reconnect motor for reverse direction of rotation.

II. Students connect 3-phase single voltage motors for clockwise and counter-clockwise operation.

ELECTRICITY

CONTENT TITLE: 3-Phase Dual Voltage Electric Motors

SUB OBJECTIVE 25: The student will demonstrate ability to connect a 3-phase, dual voltage, star (Y) connected motor for low and high voltage operation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates connecting a 3-phase, dual voltage, star (Y) connected motor for low and high voltage operation.

   A. Diagram internal wiring of dual voltage, star connected motor.
   B. Illustrate parallel connection of coils for low voltage application.
   C. Draw and interpret motor connection plate diagram for low voltage connection.
   D. Connect and test run motor for low voltage.
   E. Re-diagram internal wiring of motor.
   F. Illustrate series connection of coils as used in high voltage applications.
   G. Interpret connections as depicted on connection plate diagram.
   H. Connect and test run motor for high voltage hookup.
   I. Illustrate spiral (clock-spring) method of determining hookup of motor in the absence of connection diagrams.

II. Students connect 3-phase, dual voltage, star (Y) connected motor for low and high voltage operation.

ELECTRICITY

CONTENT TITLE: 3-Phase Two Speed Electric Motors

SUB OBJECTIVE 26: The student will demonstrate ability to connect a 3-phase two speed motor.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates connecting a 3-phase two speed motor.

   A. Describe various applications of two speed motors.
   B. Diagram internal wiring of two speed motors.
   C. Identify and explain operation of low speed windings.
   D. Indicate and describe function of high speed windings.
   E. Extend diagram to match motor's external reconnection diagram.
   F. Connect and test run motor for low speed operation, noting sound of motor.
   G. Connect and test run motor for high speed operation, noting difference in sound of motor.

II. Students connect 3-phase two speed motor.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to install and troubleshoot equipment commonly encountered in industrial situations such as compressors, lighting, refrigeration equipment, pumps, exhaust fans, etc.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Motor Controls, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York).

Anderson, Edwin P., Audel's Electric Motor Guide, (Theodore Audel & Co.: Division of Howard W. Sams & Co., 4300 West 62nd Street, Indianapolis, Indiana), 1969.

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National Electrical Code 1972, (National Fire Protection Association: 60 Batterymarch Street, Boston, Massachusetts 02110), 1972.

Rosenberg, Robert, Electric Motor Repair, (Holt, Rinehart and Winston, Inc.: 383 Madison Avenue, New York, New York 10017), 1970.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Thermostatic controlled circuitry
- Pressure controlled circuitry

Communication Skills

- Review blueprint and symbol interpretation
- Equipment schematics
- Manufacturer's literature
- National Electrical Code
- Vocabulary development

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 27: The student will demonstrate ability to install a bank of lighting fixtures controlled by a pushbutton station and mechanically held contactor, in a hospital ward.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses lighting and lighting control installation.

A. Discuss uses of ac mechanically-held contactors.
B. Discuss resistive and inductive lighting loads.
C. Discuss sizes and NEMA ratings of contactors.
D. Discuss reasons for using this type of control.

II. Instructor demonstrates installation and connection of lighting and control circuits.

A. Install fixture boxes according to blueprint or drawing.
B. Select correct size contactor and install in location specified on blueprint.
C. Install mementary-contact pushbutton station.
D. Install all conduit runs as required.
E. Pull in all circuit conductors.
F. Identify each circuit; connect to circuit breakers and contactor terminals. Observe color code.
G. Connect circuit wires to lighting fixtures observing color code.
H. Mount lighting fixtures.

III. Students install and connect lighting and lighting control circuitry.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 28: The student will demonstrate ability to install and connect a 25 horsepower motor with a reduced voltage, auto transformer type automatic motor starter to operate an air compressor in a factory.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installing a 25 horsepower motor with reduced voltage starting.

   A. Explain the need for reduced current starting.
   B. Explain types of reduced voltage starters available.
   C. Explain operation of an autotransformer reduced voltage starter.
   D. Explain types of, and operation of, time delay relays.
   E. Explain operation of current sensitive relays.

II. Instructor demonstrates installing a 25 horsepower motor and reduced voltage starter.

   A. Check motor specifications and running cycle of air compressor to determine type of reduced voltage starter needed.
   B. Check location of motor and reduced voltage starter.
   C. Check location of START-STOP station.
   D. Locate and install motor starter and pushbutton station.
   E. Rough-in conduit and wiring.
   F. Connect START-STOP pushbutton station.
   G. Connect control circuit to starter.
   H. Connect power leads to starter.
   I. Connect power to motor leads.
   J. Connect to circuit breaker in panel board.
   K. Install correct sized overcurrent relays.

Continued...

ELECTRICITY

CONTENT TITLE: Equipment Installation (Continued)

SUB OBJECTIVE 28: The student will demonstrate ability to install and connect a 25 horsepower motor with a reduced voltage, auto transformer type automatic motor starter to operate an air compressor in a factory.

SUGGESTED ACTIVITIES: (Students and Teachers)

M. Depress start button to check entire operation.
N. Readjust time delay relay if necessary.
O. Observe air pressure gauge and adjust mechanical unloaders, if necessary.

III. Students install 25 horsepower motor, reduced voltage starter and pushbutton control.

CONTENT T[illegible]: Equipment Installation

SUB OBJECT[illegible]29: The student will demonstrate ability to install an engine lathe with power feed from a plug-in bus duct system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses installation of lathe and associated wiring.

A. Explain and outline construction and uses of plug-in bus duct.
B. Explain operation and various methods of connecting a drum controller.
C. Explain various types of pushbutton controls.
D. Explain three-wire control.
E. Explain methods of taking power off of a bus duct system.
F. Explain purpose and use of combination starters.

II. Instructor demonstrates installation of lathe and associated wiring.

A. Check motor full load current to determine size of circuit breaker, wiring and starter needed.
B. Select correct sized plug in circuit breaker and fasten to bus duct.
C. Install combination motor starter at a convenient point on the lathe.
D. Rough-in conduit between bus duct and combination starter. (Note: Use a short length of flexible conduit between rigid conduit and combination starter.)
E. Mount drum controller in a location convenient to lathe operator.
F. Mount START-STOP pushbutton station in a location convenient to lathe operator.
G. Pull in necessary wiring in flexible, liquid-tight conduit runs between starter, motor, drum controller and pushbutton station.

Continued...

ELECTRICITY

CONTENT TITLE: Equipment Installation (Continued)

SUB OBJECTIVE 29: The student will demonstrate ability to install an engine lathe with power feed from a plug-in bus duct system.

SUGGESTED ACTIVITIES: (Students and Teachers)

H. Install liquid-tight flexible conduit using liquid-tight connectors. Fasten all connectors securely.
I. Connect control wiring to pushbutton station and magnetic starter.
J. Connect power leads to motor (observe correct voltage connections).
K. Connect wiring between drum controller and combination starter.
L. Pull in wiring between plug-in breaker and combination starter.
M. Connect power leads to curcuit breaker in combination starter.
N. Install circuit breaker in plug-in enclosure and connect wiring.
O. Select and install correct sized overload relays in magnetic starter.
P. Energize circuit and check complete operation. (Note: Interchange leads in combination starter if motor is reversed.)

III. Students install an engine lathe with associated wiring.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 30: The student will demonstrate ability to install and connect a totally enclosed induction motor on an exhaust fan in a commercial garage, with time switch, flow switch, limit switch and louver control.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses motor, louver and control installation.

A. Discuss operation and connection of various types of time clocks.
B. Discuss operation of air and liquid flow switches and their application.
C. Discuss temperature sensing limit switches and their use in fire control.
D. Discuss installation of equipment in hazardous locations.
E. Discuss specific code requirements for a commercial garage.
F. Explain various types and sizes of magnetic starters.

II. Instructor demonstrates the installation of motor, louver and associated controls.

A. Point out areas classified as hazardous locations.
B. Rough-in all conduit and boxes.
C. Pull in necessary wiring.
D. Install and connect time clock of the proper voltage and current rating.
E. Set up time clock for the correct time cycle.
F. Locate, connect and mount the flow switch.
G. Locate, connect and install temperature limit switch.
H. Connect power and control circuits to magnetic starter.
I. Install correct sized overcurrent devices.

Continued...

ELECTRICITY

CONTENT TITLE: Equipment Installation (Continued)

SUB OBJECTIVE 30: The student will demonstrate ability to install and connect a totally enclosed induction motor on an exhaust fan in a commercial garage, with time switch, flow switch, limit switch and louver control.

SUGGESTED ACTIVITIES: (Students and Teachers)

J. Install and connect disconnect switch.
K. Connect power leads to motor.
L. Connect power to louver motor.
M. Connect louver safety switch in series with control circuit.
N. Connect circuit to proper sized circuit breaker.
O. Energize circuit and check for proper operation.

III. Student installs and connects exhaust fan motor, louver motor and associated controls.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 3I: The student will demonstrate ability to install and connect a capacitor start motor (such as used on a refrigeration compressor in a cold storage plant) to be controlled by a selector switch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses motor and control installation.

A. Discuss sizes and types of magnetic starters.
B. Discuss the selection of correct overcurrent protection.
C. Discuss method of selecting correct sized fuses or circuit breaker.
D. Discuss methods of connecting selector switch in circuit.
E. Discuss types and application of various temperature controls.
F. Discuss selection of proper type and size motor.
G. Discuss low voltage motor control.

II. Instructor demonstrates installation and connection of motor and related controls.

A. Rough-in conduit and boxes.
B. Pull in correct size conductors.
C. Connect AUTO-OFF-MANUAL selector switch.
D. Connect stepdown transformer to line.
E. Connect proper sized magnetic starter.
F. Connect motor for correct voltage rating.
G. Connect low voltage relay.
H. Connect and mount low voltage thermostat.
I. Install correct sized overcurrent protection.
J. Connect power leads to circuit breaker.
K. Energize circuit and check for proper operation.

III. Students install and connect compressor motor with associated controls.

ELECTRICITY

CONTENT TITLE: Equipment Installation

SUB OBJECTIVE 32: The student will demonstrate ability to install and connect an electric motor driven pump to operate on single phase 240 volt ac.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses electric motor installation.

A. Explain need to determine required duty cycle.
B. Explain need to determine ambient temperature of motor location.
C. Explain need for correct alignment of motor/pump shaft.
D. Explain types of motors suitable for this type installation.
E. Explain types of motor controls available.
F. Explain electrical code requirements for motor installations.
G. Explain motor terminal connections.
H. Explain pressure requirements for various systems.

II. Instructor demonstrates pump motor installation technique.

A. Calculate circuit requirements from motor name plate data.
B. Plan and lay out circuit.
C. Mount motor and pump assembly.
D. Rough-in conduit and wiring.
E. Install pressure switch and connect wiring.
F. Identify motor terminals or leads and connect for 240 volts.
G. Rotate motor/pump shaft, manually, to check for locked or tight bearings.
H. Energize circuit and test operation of motor/pump assembly. (Caution: Do not operate pump without water.)
I. Adjust pressure switch for desired cut-in and cut-out pressure.

III. Students install and connect an electric motor driven pump.

ELECTRICITY

OVERALL OBJECTIVE: The student will demonstrate ability to identify, connect, test, operate, detect malfunctions in and correct defects in the operation of manually operated, temperature operated, liquid level, pressure sensitive, flow actuated and light sensing pilot control devices.

SOURCES OF INFORMATION

Alerich, Walter N., Electrical Motor Controls, (DelMar Publishers, Inc.: P. O. Box 5087, Albany, New York).

Allen-Bradley Industrial Control Catalog, No. 101, (1201 South Second Street, Milwaukee, Wisconsin 53204).

ACADEMIC RELATED THEORY AND INFORMATION

Math

- General review of math requirements for job or further training

Science

- Temperature operated pilot devices
- Pressure operated pilot devices
- Light sensing pilot devices
- Genera. review of service requirements for job or further training.

Communication Skills

- Manufacturer's literature
- Related safety - installing and checking pilot systems
- Review career opportunities
- in electricity
  - Apprenticeship programs
  - Post-secondary training
  - Job opportunities

ELECTRICITY

CONTENT TITLE: Manually Operated Pilot Devices

SUB OBJECTIVE 33: The student will demonstrate ability to identify and connect manually operated pilot devices to control starters and motors.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor describes application of and demonstrates connecting manually operated pilot devices to control starters and motors.

A. Diagram and connect momentary start and stop station to motor starting relay and motor.
B. Diagram and connect two momentary start and stop stations to same motor starter and motor.
C. Diagram and connect drum switch to directly control 3-phase motor for forward and reverse operation.
D. Diagram and connect drum switch to directly control forward and reverse rotation of single phase motor.
E. Diagram and connect drum switch to 3-phase motor for forward and reverse operation through overload protecting, single motor starter.
F. Diagram and connect 3 button reversing station to dual reversing starters to operate 3-phase motor forward and reverse.
G. Diagram and connect two 3 button reversing stations to dual-reversing starters to operate 3-phase motor.
H. Diagram and connect 3 button reversing station to dual-reversing starters to control single phase motor.
I. Diagram and connect 3 button, 2 speed control station to dual speed control starters and two speed 3-phase motor.

II. Students connect manually operated pilot devices.

ELECTRICITY

CONTENT TITLE: Temperature Operated Pilot Devices

SUB OBJECTIVE 34: The student will demonstrate ability to identify and connect temperature operated pilot devices.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor describes types and applications of temperature operated pilot devices.

A. Describe job applications such as free-air thermostats, ducted air thermostats, liquid line thermostats and dual controlled, differential temperature thermostats.

B. Display different types, such as bimetal warp-out type, coil spring expanding type, aneroid-bellows type, resistance element type, gas filled remote bulb type and thermocouple generating types.

C. Display and explain types of electrical contacts such as spring loaded, open contacts in micro-switches, permanent magnet, snap open and close contacts and mercury bottles.

D. Display, explain and illustrate multiple configuration of contacts.

E. Discuss progressive two and three stage mercury bottles.

F. Discuss reverse acting, mercury bottles (heating and cooling function).

G. Demonstrate connecting thermostat to magnetic gas valve on central heating unit. (Free air type.)

H. Demonstrate connecting dual element thermostat to boiler magnetic gas valve and 3-way hot and chilled water transfer valves.

I. Demonstrate connecting two stage thermostat to two motor starter motors. Apply heat to sensing elements to demonstrate staging of thermostat.

II. Students identify and connect temperature operated sensing devices.

ELECTRICITY

CONTENT TITLE: Liquid Level Pilot Devices

SUB OBJECTIVE 35: The student will demonstrate ability to identify and connect liquid level pilot devices.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor describes and illustrates applications of liquid level pilot devices such as sump pumps, water tanks, chemical plant vessels and fuel storage tanks.

   A. Display different type liquid level devices such as float, immersed electrode and floating permanent magnet types.
   B. Display and explain switch operation of micro-switches, current flow through water between electrodes and floating magnet type armature devices.
   C. Diagram and connect float type switch to motor starter and water pump motor.
   D. Demonstrate float conduit of pump motor.
   E. Diagram and connect immersed electrode type liquid level control device to pump motor.
   F. Demonstrate positioning of electrodes to control water level.
   G. Diagram and connect floating magnet type liquid level switch.

II. Students identify and connect liquid level pilot devices.

ELECTRICITY

CONTENT TITLE: Pressure Sensitive Pilot Devices

SUB OBJECTIVE 36: The student will identify and connect pressure sensitive pilot devices.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor identifies and connects pressure operated pilot devices.

A. Describe job applications requiring use of pressure operated switches such as air compressors, water pressure safety lock-out controls, oil pressure safety lock-out controls and silos containing dry materials such as grain, cement, lime, sand, etc.

B. Display types of pressure switches and explain their operation; include banana tube, metal diaphram and rubber diaphram types.

C. Diagram and connect pressure switch to control air compressor through motor starter.

D. Demonstrate adjusting switch for correct cut-on and cut-off pressures.

E. Diagram and connect pressure switch on water line to kill water cooled machine if water pressure drops below required level.

F. Demonstrate adjusting pressure switch to specified pressure.

II. Students identify and connect pressure operated pilot devices.

ELECTRICITY

CONTENT TITLE: Flow Actuated Pilot Devices

SUB OBJECTIVE 37: The student will demonstrate ability to identify and connect flow switches.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor identifies and connects flow switches.

A. Describe job requiring the use of flow switches. Include switches to monitor water flow over instant heat immersion water elements, water flow through water cooled machines and air flow through evaporator coil ducts.

B. Display types of flow operated switches describing their operation.

C. Connect flow switch mounted in plastic sight glass pipe on discharge line of pump to control immersion heater contactor.

D. Connect test light to indicate opening and closing of flow switch as water flow increases and decreases.

II. Students identify and connect flow switches.

ELECTRICITY

CONTENT TITLE: Light Sensing Pilot Devices

SUB OBJECTIVE 38: The student will demonstrate ability to identify and connect light sensing pilot devices.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor describes practical applications of light sensing control devices such as street lighting control, burglar alarm systems and unit counting systems for conveyor lines.

A. Display types of light sensing devices.
B. Describe theory of operation of photo-electric cells, light sensitive resistance cells, etc.
C. Diagram and connect light sensitive cell to operate mercury vapor street light.
D. Demonstrate operation by blanking and opening eye to cell.
E. Diagram and connect light sensitive cell to two-pole relay, alarm bell and normally closed press-to-silence switches so that breaking a concealed light beam activates the relay, sealing in and setting off alarm bell which keeps ringing until circuit is broken by pressing the press to silence alarm button.
F. Remove cover from cell exposing and identifying component parts.
G. Demonstrate diagramming of internal wiring.
H. Using an ohmmeter, measure resistance of eye (on resistance type cells) with light beam striking eye.
I. Note difference in resistance reading with eye shaded from light beam.
J. Diagram and demonstrate simple method of testing cell for proper operation by connecting 115 volt supply to line and neutral terminals and 115 volt test lamp from neutral to load terminals. (Light should blink on and off.)

II. Students identify and connect light sensing pilot devices.

ELECTRICITY

CONTENT TITLE: Manually Operated Pilot Devices

SUB OBJECTIVE 39: The student will demonstrate ability to identify and connect manually-operated pilot devices to control starters and motors on an interlocked 90 ton air conditioning system.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor identifies and connects manually-operated pilot devices.

A. Draw and identify symbols representing the devices as being normally open, normally closed, transconfigurated, maintained or mementary contact devices.

B. Diagram typical circuits in which they may be used.

C. Connect the following devices to motor controlling relays:

1. Single pole, maintained contact relay.
2. Single pole, momentary contact (as used in jogging motors) relay.
3. Single pole, double throw with maintained ON, OFF and momentary-ON (as used on automatic, off, and test applications).

II. Students identify and connect manually-operated devices.

APPENDIX

ELECTRICITY

LESSON PLAN SAMPLE

OVERALL OBJECTIVE:	The student will lay out and construct a simple series and parallel circuit.
SUB OBJECTIVE:	Construct a simple electrical circuit.
TOOLS AND MATERIALS:	Romex, pigtail light socket and bulb, solderless terminal connectors, test cord and linemans pliers.
I. Preparation	Chalkboard diagram of simple circuit, also student handout worksheet.
II. Presentation	Demonstrate construction of simple circuit stressing safety and correct construction procedures.
III. Application	Students construct simple circuit.
IV. Performance Tests	

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ABSTRACT: THIS STUDENT RESOURCE MANUAL FOR CAREERS IN ELECTRICITY IS INTENDED TO SERVE AS A SUPPLEMENTAL TEXT AND INFORMATION MANUAL. IT IS DESIGNED AND WRITTEN FOR STUDENT USE AND IS STRUCTURED TO COMPLEMENT THE INSTRUCTOR'S GUIDE FOR ELECTRICITY (VT 102 415 IN THIS ISSUE). THE UNIT TITLES FOR THIS MANUAL ARE: RESIDENTIAL WIRING, COMMERCIAL WIRING, INDUSTRIAL WIRING, SAFETY, AND AFTER GRADUATION. DESCRIBED IN THE THREE UNITS ABOUT WIRING ARE SITUATIONS AND CONCEPTS ENCOUNTERED ON THE JOB. A GLOSSARY AND LISTS OF RESOURCE MATERIALS ARE ALSO INCLUDED. (AUTHOR/LJ)

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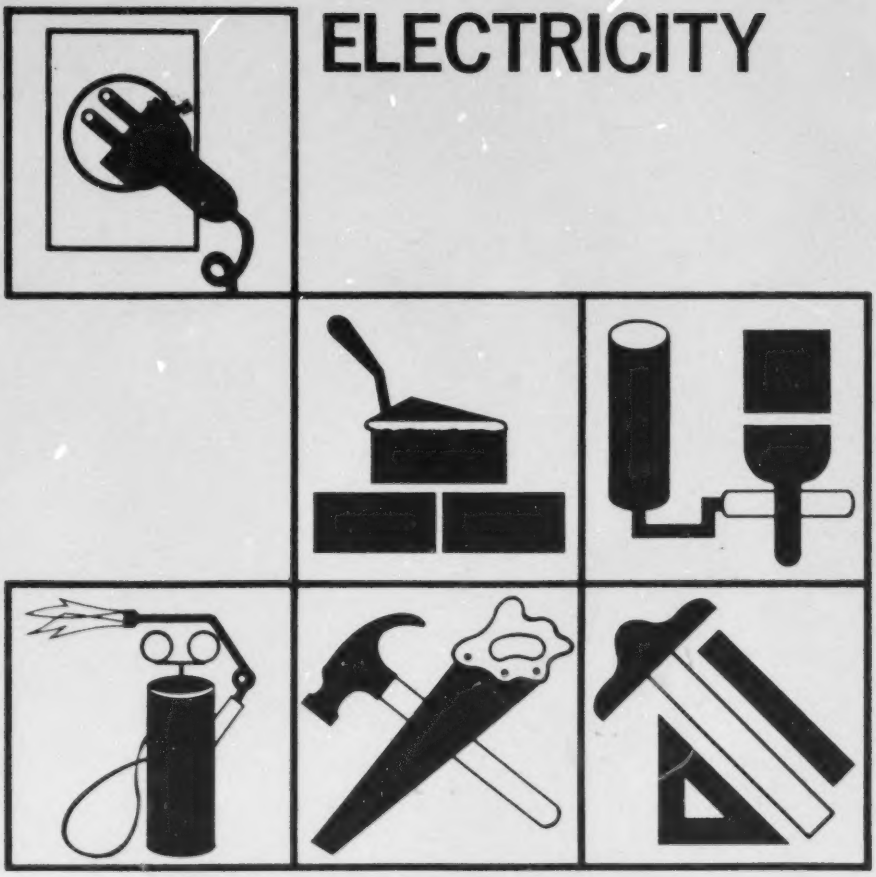

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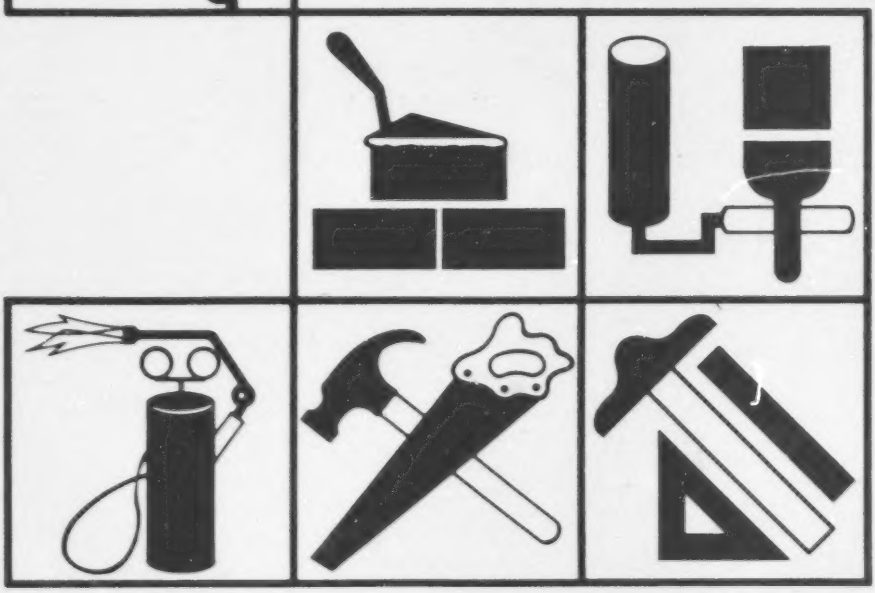

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This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

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Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

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Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
Metal - Student Manual
Metal - Instructor's Guide
Electricity - Student Manual
Electricity - Instructor's Guide
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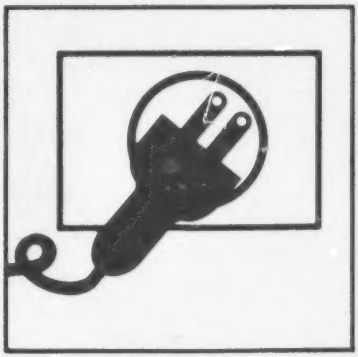
ELECTRICITY

INTRODUCTION

Let's look at some of the jobs which are performed by electricians. Depending on the construction project, electricians plan, lay out and install wiring in residences, commercial and industrial buildings. Each wiring project differs from others.

One of the first things done on a construction site is the locating and setting up of a temporary service loop. This loop provides the electricity needed during the construction phase of the project — electricity to operate saws, compressors, drills and other tools and equipment. It is generally the responsibility of the electric power company to make all connections from the utility pole to the temporary service loop.



RESIDENTIAL WIRING

ROUGH-IN

There are two separate phases performed by electricians on new residential construction — rough-in work and finish work. The electrician becomes involved in the construction process after the exterior walls and roof have been framed and the building dried in.

This is the time for the rough-in phase. Using the wiring blueprints, the electrician and helpers locate the spot where the utility pole conductors will be tied to the building. The electrician assembles and installs the conduit, weather-head and meter loop, main disconnect and the interior circuit breaker panels. This interior circuit breaker panel will become the heart of all wiring inside and outside the building. Complying strictly to electrical codes and specifications, the electrician locates and sets utility and receptacle outlet boxes. Holes are bored and wires pulled through and stapled. Usually, romex wire is specified in residential construction.

Romex is a name given to a type of wire, and it is normally referred to by the size of the wire and the numbers of wires that are wrapped together in a plastic cover. A 12-2 with ground means there are two insulated wires or conductors, each with a sizing of 12. There would also be a ground wire. This wire with ground is the most common wire used in residential circuits.

All circuits originate at the circuit-breaker box and spread throughout the house. During the rough-in phase, all wiring must be completed before the walls and ceilings are insulated and covered with gypsum wallboard. Therefore, the electrician and helpers must work rapidly, but exactly. Correcting wiring mistakes can be costly to the electrical contractor if they have to be made after the walls and ceilings are covered.

After the rough-in phase is completed and before the walls are closed in, an electrical inspector must inspect and approve the wiring system. Strict code requirements must apply. Any improper wiring practices must be corrected and inspected again. Delay to the overall construction project, for whatever reason, will cost the contractor money.

To do rough-in wiring, electricians and electrician helpers read and accurately interpret blueprints and building specifications. They measure, cut and bend rigid and thin wall conduit tubing. They measure, locate and place various boxes and run wires to these boxes. All wiring connections must be made securely, correctly and safely.

CIRCUITS

In residential construction, there are two basic circuits — 230 volt and 115 volt. Electric ranges, water heaters, heating and cooling systems, pumps and dryers are almost always wired for 230 volts. Lighting and outlet boxes are generally wired for 115 volts. They are wired with 12-2 wire and are grounded circuits. There may be several lighting fixtures or outlets on one circuit. It is important that all of these items are wired using the two color wiring code — black for hot wires and white for common wires. Ground wires are usually bare, but in some cases may be green in color. On outlet receptacles, the hot or black wire is tied to the gold screw, and the common or white wire is tied to the silver terminal. The colored plastic insulation on each wire is stripped just enough to make the connecting loop if screwed terminals are used. On push-in quick connectors, a scale for stripping is usually printed on the receptacle.

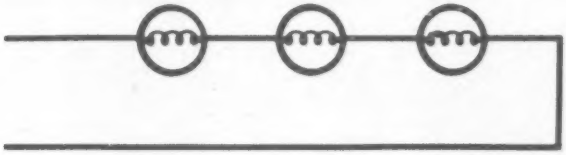
Today, the most common type of connectors for wires are the solderless screw-on type. The wires are stripped and pig tailed together, trimmed and the connector is screwed on tightly. A wire coil inside of these connectors will draw and lock in the wires together. No bare conductor should show from under the shield of the connector. A firm tug should be applied to the connector to check for a secure connection. All connections, whether screw, push-in, taped, soldered, etc., should be checked in the same manner.

WIRING OF SWITCHES

The wiring of single pole switches will not conform to the regular use of the two color code. These wires should be thought of as both black, as switches should only open and close the hot side of the circuit. When wiring an spst switch, it will be necessary to connect a white wire to the black wire going to the light. Nearly all switches used in residential construction are placed in series with the circuit. Here is an example of how a switch is diagramed in series with a circuit.

This circuit is now opened and the lights are not on. When the switch is closed the lights will burn if all of the bulbs are good.

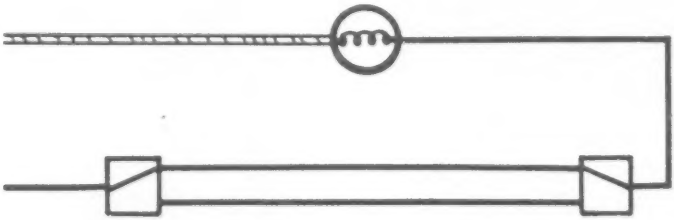
The lights of this circuit are in a parallel circuit, and you can see the basic differences between series and parallel circuits. A circuit of lights wired in a series would be diagramed this way.



A simple circuit only has one light or appliance and is diagramed this way.

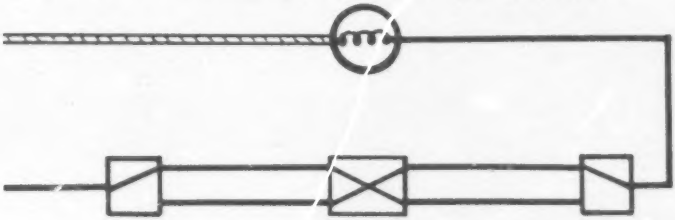
You can see that this circuit can be described as either series or parallel, but, to avoid this problem, it is called a simple circuit.

Nearly all of the operational circuits in homes today are parallel, but there are other switches used in residential construction. The spst switch has been described and diagramed above. The three way switch and its function is diagramed this way.



The circuit can be opened and closed from either switch. In this diagram, the light would be on. Use of these switches include control of lights in a larger room, with switches placed at two entrances/exits to the room. Also, garage lights can be wired this way to permit lights to be turned on and off from inside the house or garage.

Another type of switch that is sometimes used in residential construction is the four-way switch. It is diagramed this way.

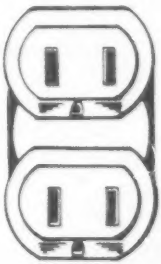


You can see that it utilized the basic three-way diagram, but now includes a four-way switch connected to the traveler wires between the two, three-way switches. The light in the diagram would not be on. This light now can be controlled from three different positions in a room. This type of switch might be used in residential construction to control lights in hallways and stairways, in addition to lights in larger rooms.

There are other kinds of switches that are used in homes today. Push button, pull chain, timer, temperature controlled, photo electric cell, pressure and many others. Their functions are exactly alike — to open and close the circuits that they control.

WIRING OF RECEPTACLES

In residential wiring there are many types of receptacles that are used. The most common are drawn below.



Parallel slot — 115 volt receptacle; usually one receptacle includes a pair of outlets

Tandem slot — 230 volt receptacle; in pairs or single outlets

Crow foot — 230 volt; usually mounted as a single outlet

These three receptacles are by far the most common. There may be special outlets however, for plugs on some appliances. An example of this would be receptacles required by different manufacturers of clothes dryers.

All of these receptacles should be wired properly, including the wiring of grounds.

Wiring of Dimmers

Another device which is frequently installed in residential wiring is a light dimmer. There are two types of dimmers: One for fluorescent lights and one for incandescent lights. Dimmers for controlling fluorescent lamps are variable reactors or choke coils that control the amount of *current* flowing through the lamps Dimmers for controlling incandescent lamps are variable resistors that control the *voltage* to the lamps. Let us first look at how incandescent dimmers are installed.

Incandescent dimmers are relatively simple. There are two types: Three-way dimmers and rotary dimmers. The three-way has three positions: High, low and off. They are wired into a circuit, as is any single pole switch, with two wires to connect. Rotary dimmers can be set to any degree of lighting, from zero lighting (off) to full lighting. As the switch knob is turned clockwise the light becomes brighter; when turned counterclockwise, the light dims. Rotary dimmers also have only two wires to connect and are wired in as a single pole switch.

Fluorescent dimmers are similar to incandescent dimmers, but are somewhat more complicated. In addition to the dimming switch, a special transformer is installed. The transformer feeds current to the lamp. In turn, the transformer is fed current from a dimmer switch similar to those used with incandescent lights.

When the electrician installs dimmers, the first thing he does is to check the plans for the electrical system being installed to find the exact spots where the dimmer switches and connected wiring should be installed. Next, the proper distances from floor to ceiling are measured off, and boxes and wiring are roughed-in. Lighting fixtures are attached and wired in. The dimmer then is wired to the ground box and into the circuit. The circuit is connected to the power and tested.

Fluorescent Lighting

In discussing dimmers, fluorescent lighting was mentioned. One task which electricians frequently do is to install a fluorescent lamp controlled by a single pole, single-throw switch. Let's look at some of the special requirements of fluorescent systems.

Incandescent lighting produces light by running electrical current through a tungsten thread, called a "filament", inside the light bulb. As current flows through the filament, it becomes white hot. The light from incandescent lamps comes from this glowing white-hot filament. On the other hand, a fluorescent bulb produces light by heating mercury until it vaporizes. An electrical current is passed through the mercury vapor. Electrons from the mercury vapor strike the powder, called "phosphor," and cause it to glow. It is the flow from the phosphor which creates the light from fluorescent lamps. High voltage is run through the tube when the light is started; then, when the mercury vapor has filled the tube, a low voltage is maintained. The voltage is raised and lowered by special transformers, called "Ballasts," built into fluorescent lighting systems. The ballast also controls the exact amount of current flowing through the lamp at any given moment.

A second device used in fluorescent lamps is the lamp starter. In order to understand what a lamp starter does, let's look again at what happens in a fluorescent lamp. When the current is turned on, mercury is vaporized — that is, heated until it turns into a gas. Then current is set flowing through the gas. There are two steps in the process, and, in between the two steps, current in the bulb is turned off. It is the starter which shuts off the heating current and starts up the arc which actually lights the bulb.

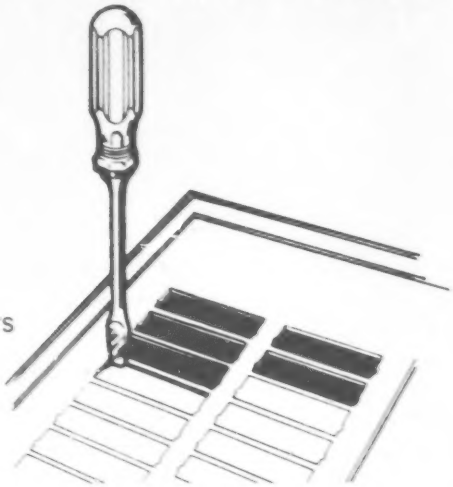
Circuit Breakers

When electricians wire a residence they install devices called "circuit breakers." Circuit breakers shut off the flow of current when a circuit is overloaded. There are two types of devices which trip circuits. One is constructed with a bimetallic switch somewhat like a thermostat. When an overload occurs, the switch heats up and shuts off the circuit just as a thermostat does. The second tripping device is operated by an electromagnet which becomes strong enough to pull open the circuit when an overload occurs.

The National Electrical Code is now requiring the use of ground-fault circuit breakers on outlets located in "hazardous" locations. The intent of the ground-fault breaker is to protect the users of electrical appliances from electrocution. It's theory is that if more current is flowing in the "hot" wire than is returning through the neutral, then the extra current may be going to ground through the operator of some appliance. It interrupts the circuit before the "last" current reaches injurious proportions.

Circuit breaker panels are installed in much the same way that other panel boards are installed. There are several different types of circuit breakers used. Most of those installed in residences fit

into panel boards. Circuit breakers are rated according to their capacity to carry amperage, that is, their ampacity. Circuit breakers on 120 volt lines use single pole switches; those on 240 volt lines use double pole switches. Each circuit is wired into its switch as any other switch is wired. Panel covers have "twistouts," which are spots where metal plates may be knocked out with a screwdriver so that there will be a place for the breaker switches.

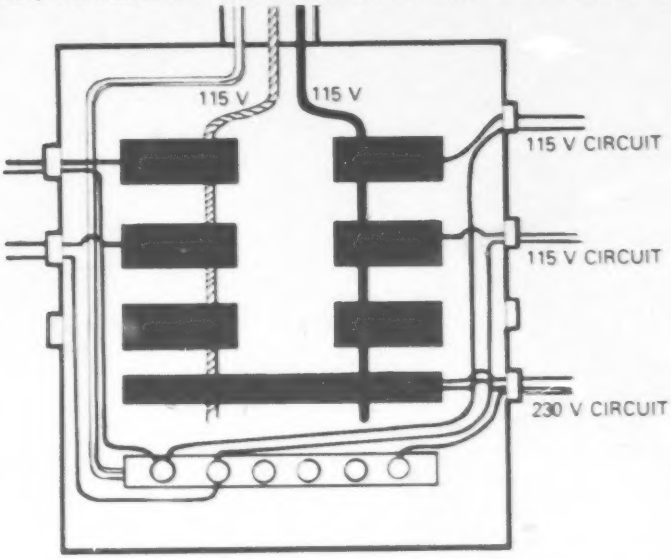


Circuit breakers and fuses provide a vital service. They are a safety valve to appliances fed by that circuit. Should something go wrong, the breaker or fuse will open at the source of power to that circuit. This action prevents abnormal heat build ups in the wires. If not checked by a circuit breaker or fusing device, the wires of the circuit will heat up, and, at the very least, damage the entire circuit or cause a fire within the walls or ceiling of the residence. Therefore, every circuit should include these very important safety devices. They should never be bypassed or tampered with in any way.

When an electrician installs a circuit breaker, first, the circuits are laid out in the house. Next, the panel board is attached to the wall either with clips or screws. All 120 volt circuits are identified and marked. Those circuits which are unidentified, should be wired to single pole switches. Then all 240 volt circuits are located and connected to double pole switches. Grounding conductors are then fastened to the grounding conductor. The breaker board cover is attached. At last, a diagram of the circuits is attached to a card in the panel cover.

Wiring of Appliances

Electricians also connect wiring to electrical kitchen equipment such as ranges, cooking burners, ovens, garbage disposals and electric clothes washers. Let's look at some of these operations. One of the simplest is to install a cook-top unit and a built-in oven. When an electrician starts to install these units, calculations must be made on the circuit requirements for each appliance. Usually a circuit is run from the service entrance to a panel board



in the kitchen. From there circuits are run to the different appliances. A cooking top will use about 5 or 6 kilowatts and should be wired to allow 30 amps to pass. A wall oven will use about 4 or 5 kilowatts and use about 26 amps. Usually No. 10-3 cable connected to 30 amp circuits is used. When an electrician is wiring in a cooking-top and oven, voltage drop must be considered. Voltage drop, or line drop, is the voltage lost in the circuit. It is caused by resistance in the wiring and is turned into heat between the electrical source and the place where it will be used. Usually no more than a 1% line drop is allowable in circuits to cooking-tops and ovens. About 35 feet of No. 10 cable or 55 feet of No. 8 cable will give a 1% line drop.

After the electrician has calculated voltage drop and the circuits needed, the boxes that will be needed are roughed-in. Behind each unit — the cooking top and the oven — a 4 inch box is installed. Cable is then attached to the wiring of the appliance.

The oven and the cooking top are grounded to the neutral wire of the supply cable. This cable is at least No. 10. Finally, the covers of the boxes are attached and the appliances slid into place.

Another kitchen appliance frequently installed is a garbage disposal unit. Garbage disposals have certain circuit requirements. The electrician needs to check the directions supplied by the manufacturer of the equipment in order to determine exactly how the wiring should be connected to the unit itself. Plans are then checked to locate the garbage disposal. The boxes and wiring are roughed-in and the motor control switch is wired in. Then, leads from the box are connected to the disposal unit itself. Finally, the grounding conductor is connected to the disposal.

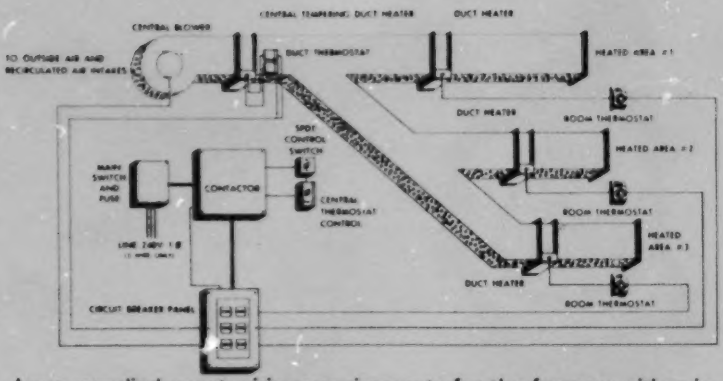
Another appliance often installed is the dishwasher. The appliance should be checked to determine the circuit load. Whatever boxes and wiring are needed should be roughed-in. The dryer should be connected to the circuit. Often a special receptacle will be installed into which the dryer cord can be plugged. The dryer receptacle should be mounted on a 4 inch box. The cover plate on the back of the dryer should be removed. The cord from the receptacle should be attached to dry terminals. Flexible grounding braid should be attached to the grounding conductor. The other end of the grounding braid should be attached to the grounding terminal on the dryer. Finally, the dryer should be leveled and pushed into place.

Wiring of Other Systems

Electricians also install a variety of automatic (or "servo-controlled") electrical systems for heating, cooling, door chimes and remote controlled lighting.

For instance, one job an electrician might be asked to do is install a 15 kilowatt electric furnace and its controls. An electrician should first have some knowledge of electric furnaces and other heating devices before beginning to install one. In an electric furnace, heating elements become red hot. After the elements heat up, fans blow air across the elements. This heats the air. It then flows down metallic ducts and out into the different rooms of the house. Smaller heaters are mounted in walls or ceilings and are used to heat individual rooms of a house. These types of electric heaters operate on the principle that when electric current flows through a highly-resistant conductor, the conductor produces heat and light, as in an incandescent light bulb.

When an electrician installs an electric furnace, the first thing done is to check the designs to locate exactly where the furnace and its controls should be placed. The furnace manufacturer will



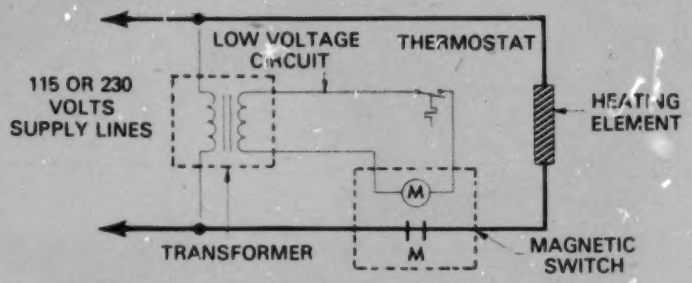
have supplied exact wiring requirements for the furnace, either in a booklet, or engraved on a plate on the furnace itself. The size of wire and the number of circuits needed should be calculated. The wiring for the furnace circuits should be roughed-in from the main panel.

An electric furnace may be wired into a 115 volt, two wire circuit, using No. 12 wire. Usually 15 or 20 amps will be a sufficient current limit. Then wiring should be roughed-in between the thermostat and the furnace. The wiring diagrams provided with the thermostat and the furnace should be followed exactly. The thermostat should be placed on an interior wall, out of drafts. Power should be turned on, and the operation of the thermostat and furnace should be checked.

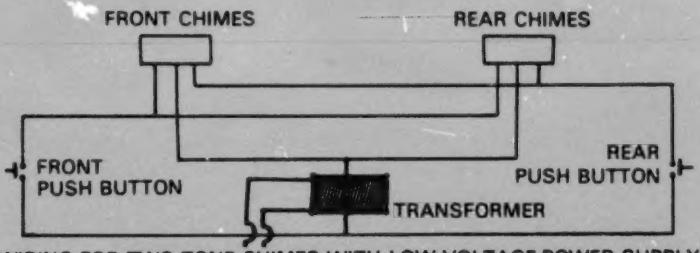
Electricians also install automatic controls on natural gas furnaces. As with electric furnaces, the first step the electrician takes is to locate the exact spot where controls and their wiring should be placed. Then the operating manual, or nameplate rating of the furnace should be checked to determine circuit requirements. With this information, circuits can be laid out.

To understand what circuits are needed, let's review what electric controls are available. First of all, thermostats of different types are used to turn a furnace on and off. The type used in any given place depends on the type of furnace used. One type, used with water heating systems, has the thermostat submerged in a pool of water. It is set to shut off when the water temperature reaches a certain level. Another device, called a pressurestat, is used with steam heating devices. Instead of turning the furnace off when a given temperature has been reached, the pressurestat turns it off when a set pressure is reached. Another device, called the furnacestat, is mounted in the bonnet of the furnace and keeps it going until the temperature rises to a preset air temperature.

The actual process of installing a thermostat begins with the electrician checking plans and determining exactly what type of thermostat should be installed and where it should be located. Then, the wiring is roughed-in. Relatively low voltage wiring is used to connect current from the thermostat to the furnace. A fused switch is placed near the external wall. A junction box is placed on the outside wall. The control cable is fed in. Conduit and wire is connected between the junction box, the switch box and the AC unit. Finally, the thermostat itself is mounted and wired in. Here is an example of a thermostat circuit diagram.



Besides installing electric heaters and thermostats, electricians also often install door chimes. Let's see how a door chime with front and back door buttons would be installed. Circuits for door chimes are relatively simple including a power source, a low voltage transformer, a pushbutton and a bell. Basically, the bell and the pushbutton are in a series circuit. Other pushbuttons may be wired in together, parallel to each other. The wiring used should be low voltage wiring, stapled down, loosely, with insulated staples. Frequently, chimes are installed which sound different tones, depending on whether the button at the front or back door is pressed. In this case, two chime units are connected in parallel. Each unit has three wires. If the front door button is pushed, the front chimes alone will sound. If the back door button is pushed, both chimes will sound. Here is a wiring diagram for this type of set up.



WIRING FOR TWO-TONE CHIMES WITH LOW VOLTAGE POWER SUPPLY

When installing door chimes, the electrician first checks the blueprints to determine exactly where the chimes, the transformer and the pushbuttons should be located. Next, the power circuit to the transformer box is roughed-in along with low voltage wiring. Care is taken in stapling it so that the insulation is not cut. The circuit is connected to the pushbuttons with the buttons mounted next to the doors with small nails or screws. The control and circuit wires of the chime are then connected. The grounding conductor is fastened to the transformer box. Finally, the circuit and low voltage wires are connected to the low voltage transformer.

Besides installing door chimes, electricians install low voltage remote control lighting systems. These systems differ from ordinary switches in that they require 24 volts rather than 115 volts. Remote control switches use a relay to switch the current on and off. An electromagnet pulls the switch OFF and ON. The electrician checks the plans and locates where the fixtures and switches should be placed. The boxes and wiring for a 120 volt system are roughed-in. A four inch square box is mounted to hold the transformer. Next, the necessary low voltage wiring is roughed-in. A low voltage relay is set in one of the 1/2 inch knockouts at each light or receptacle box. The low voltage leads and switch legs are spliced to the transformer leads. The 120 volt power leads are spliced inside the box. The light fixture or receptacle is wired into the box. Switch leg conductors are attached to each switch. Each switch should be mounted on a raised plaster ring. Each ring then, is connected to the master selector switch. This switch is fastened to the wall, as are the others. Power is connected to secondary terminals.

Other voltage systems installed are home radio, intercom and TV antenna distribution systems. When an electrician installs an intercom system, the first step is to check the blueprints to determine the type of system. The electrician locates where the control and slave stations should be placed. The boxes and wiring are roughed-in. The wiring for the intercom system should not be adjacent to the house wiring. A step-down transformer is mounted in the panel board. The line side of the circuit is wired into the transformer. Next, the low voltage cable from the transformer to the master station is wired in. Power leads are wired into the master station. Remote speakers are connected and mounted. The step down transformer is mounted in the panel board and line side of the transformer is wired in. Finally, the master unit is connected to an antenna mounted in the attic.

Electricians also install TV antennas and lead-in cables. There are many different types of antennas on the market. In order to install any given antenna properly, the electrician should study the direc-

tions supplied by the manufacturer. The electrician should check blueprints and specifications to determine exactly where the antenna and television outlets should be placed. The next step is to install the antenna mast and the antenna. All lead-in cable should

be roughed-in. This cable should be placed at some distance from all AC wiring. The coupler should be mounted; the lead-in cables should be connected according to a diagram supplied with the coupler. The antenna mast should be grounded to an electrode driven into the ground. The lead-in cable should be connected to the antenna. Finally, the cable should be attached to a specially designed TV outlet.

New construction work is usually clean, safe and not dependent on weather conditions. The tools and testing equipment are not heavy and not difficult to handle. But, again, the work is just another in the overall construction sequence. There are only a few days set aside in this construction sequence for rough-in work. Electricians must be in and out on time.

After the rough-in work has been completed and inspected, electricians leave the project. They will return after other work has been completed for their finish phase.

COMMERCIAL WIRING

INTRODUCTION

Commercial wiring utilizes most of the basic techniques used in residential wiring. However, it requires more complex skills, knowledge and tools than does residential wiring. Frequently, the electrician is called upon to work with higher voltages and amperages. Some typical tasks for an electrician on a commercial job would be installing tri-plex cable, approved wiring for use around explosive gas and dust environments, installing mineral insulated cable (article 330 National Electrical Code), metal-sheathed cable, armored cable, metal-clad cable (article 334 National Electrical Code), electrical metallic tubing, liquid-tight flexible conduit and rigid metal conduit. Each of these types of cable or conduit requires a somewhat different process of installation.

TRI-PLEX CABLE

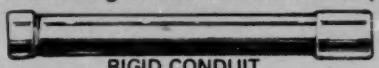
Let's look at the installation of tri-plex cable. First, porcelain screw insulators should be attached to supports. Cable strain clamps then should be fastened to the insulators. The exact amount of cable needed should be measured and cut to the desired length. Finally, the cable messenger wire should be attached to the strain clamps.

METALLIC CABLE

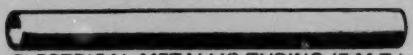
Another type of material used in commercial wiring is metallic cable. When metallic cable is being installed it should first be measured and cut. A length of outer sheathing should be removed with a hacksaw or with pipe cutters, and the end of the cable sealed off. The individual conductors contained in the cable should be insulated. Lastly, the cable should be attached to the outlet box.

METALLIC TUBING

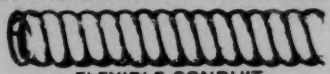
Let's look at the basic operations performed on electrical metallic tubing (EMT). This tubing comes in a wide variety of sizes, 1/2 to



RIGID CONDUIT

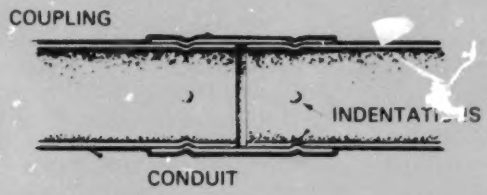


ELECTRICAL METALLIC TUBING (E.M.T.)



FLEXIBLE CONDUIT

4 inches in diameter. EMT has extremely thin metallic walls, and, therefore, it must be bent with a bender specifically designed for each size of EMT. When installing it, the electrician should measure the exact length needed. This length should be cut with a hacksaw which has a very fine toothed blade. The burrs left on the conduit should be removed with a reamer. The EMT should then be attached to the conduit with EMT couplings. EMT couplings are used because EMT cannot be threaded. Ends of EMT are set into couplings and a set screw is tightened to hold them in place. Indented couplings are also frequently used. The



conduit end is slipped into the coupling, then the indenter tool is used to indent the coupling and the EMT. Conduit is coupled to boxes in much the same way in which it is coupled to other pieces of conduit.

FLEXIBLE METAL CONDUIT

Another type of conduit frequently installed is flexible metal conduit. This conduit is fitted in much the same way as EMT, except that it is not rigid. The first step is to measure the exact amount of conduit needed. When the proper length of conduit has been laid out, it should be cut with a hacksaw. After has been cut, burrs remaining should be removed with pliers. A flexible conduit connector should be attached to the end of the conduit. Finally, the connector should be attached to the outlet box. In extremely damp places electricians will often install liquid tight flexible metal conduit. This is a metal conduit especially made to be water tight. The conduit is cut to the proper length with a hacksaw. The burrs are cleared away. Then a liquid tight metallic bushing is installed in the end of the cable. The cable end is inserted into the end of a flexible connector. The connector is then reassemble and tightened.

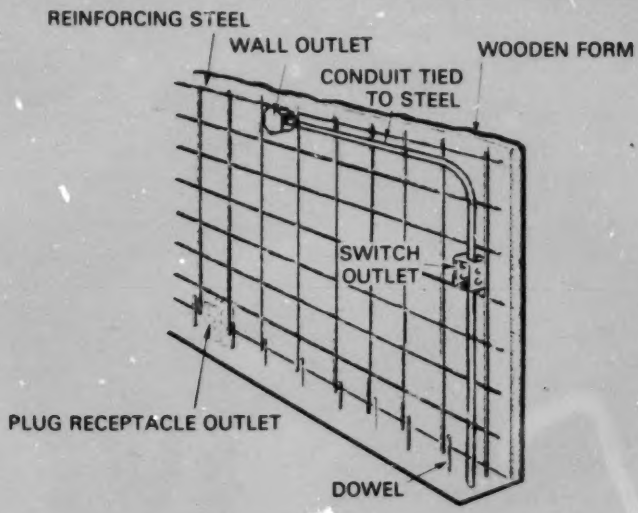
INSTALLING CONDUIT IN CONCRETE FORMS

In commercial wiring installations, electricians often must plan, layout and install conduit in concrete forms. One task is planning

and laying out the location of floor-fed wall outlets. The first step is to measure from the outside forms and to locate the exact position of each future wall. The dimensions of the rooms should be carefully marked off. The location of each outlet should be measured exactly as drawn to scale on the electrical plan. The electrician should then check the National Electrical Code and plan his circuit routing and engineering specifications to determine the sizes of conduit which will be required. The depth at which the conduit should be buried and height of bends, or risers should be noted. Once this is done, the floor layout is made by making a worksheet sketch. This sketch shows each conduit run and includes the types, locations and angular size of each bend. On the sketch the distance between each bend should be marked off. Finally, the size of conduit to be used should be noted and marked on the drawing.

After the exact information concerning the layout of the conduit has been sketched, it should be marked off on the deck, showing the conduit routing, the height of each outlet above the floor and the size of each conduit.

Once the conduit system has been laid out and marked off, the conduit should be bent to its proper shape. Usually a hickey bender will be used for this. Let's look for a moment at the way this is done. The first step is to measure the exact length of the bent part of the conduit. This length should be marked off on the conduit. Five inches should be subtracted from this (for 1/2 inch conduit) and marked off (7 inches for 3/4 inch, 9 inches for 1



inch). The conduit should then be laid out on the floor and the hickey should be slipped over it. One foot should be placed on the pipe to hold it in place. The back end of the hickey should be placed on the second mark. The other foot should be placed at the back of the hickey and held against it tightly. Then the electrician should press down until the conduit reaches the desired 90° angle. After the conduit has been bent to the desired angle, it should then be installed; that is, run to outlets in the walls and ceiling. The electrician should install concrete ring boxes and fixture cans where the plans call for them. Each of the previously bent lengths of conduit should be attached to the proper outlet boxes and wired tightly to the rebars. The ends of each run of conduit should be plugged and covers placed on the boxes. Finally, when conduit is in place, the electrician should install outlets in the walls and connect them.

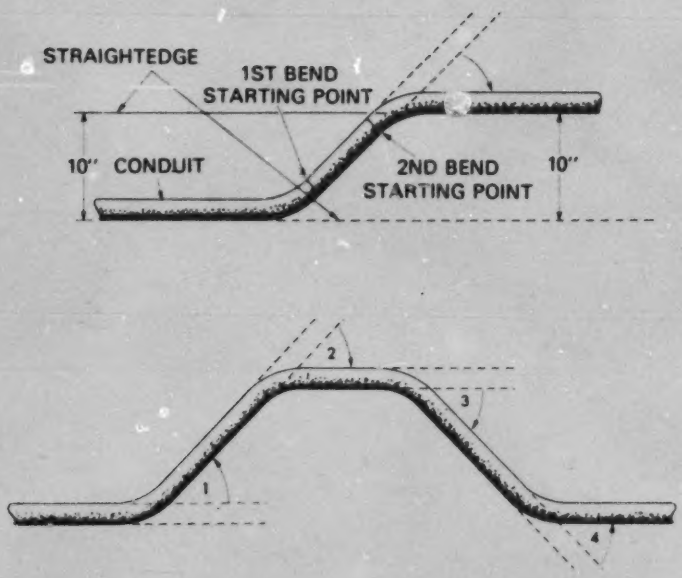
OUTLETS INSTALLED

When outlets are to be installed in concrete columns or walls, the first step is to define the type and location of the outlets. Next, the size of conduit to be used should be calculated. Conduit location should be sketched in on a rough plan. The conduit needed for the run should be bent and fitted. The conduit should be sealed and the outlet boxes packed. The outlet box should be attached to the concrete form, and the conduit should be wired to the reinforcing steel.

PIPE SLEEVES

Electricians also install pipe sleeves in concrete beam forms. The first step is to mark the exact spot where the sleeve should be placed. A circle should be marked on the beam. With a brace and bit, a hole should be bored through the beam. Then a circle should be sawed in the form with a compass saw. The sleeve should be pushed through the hole to the opposite beam form. The beam should be leveled and squared in the hole with a tri-square, and a hole should be sawed on the opposite side of the beam form. The sleeve should be inserted through both holes of the form. It should then be wedged into place with a 16d penny nail.

Electricians frequently must make rigid conduit follow around curves. In order to do this, on many projects they find themselves making kicks, offsets and saddles, in 1/2 to 5 inch rigid conduit. Kicks, offsets and saddles are similar to angled bends. The electrician lays out the necessary length and allows for losses in the process of bending. Then a hickey or hydraulic bender is placed on the mark and the bend is made. The angle is measured



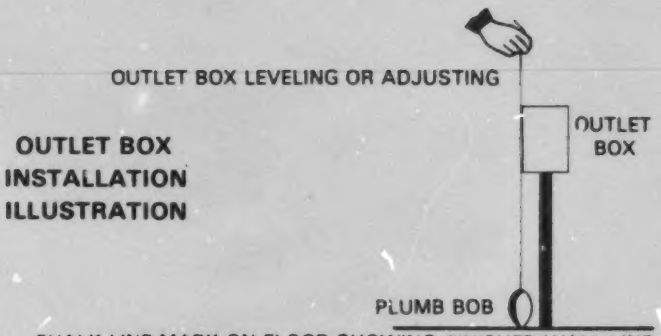
with a protractor. No matter what angle is to be formed or how many bends are to be made, the process is similar, varying only with the size conduit to be bent.

INSTALLING FLOOR DUCT SYSTEMS

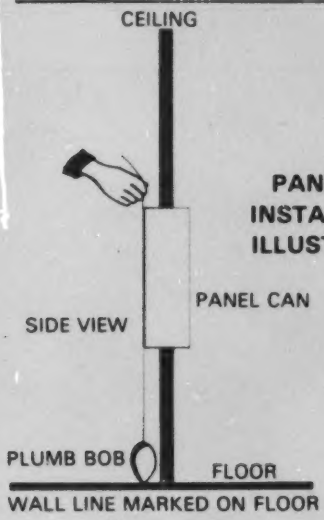
Another job for commercial electricians is to plan, layout and install floor duct systems. The first step is layout. A floor duct system is a series of race ways in which wire is installed. The electrician first makes a working drawing which shows how the ducts are joined and then divided off. It shows where each of the electrical outlets should be placed. Then the drawing should be transferred to the deck. The next step is to mark the size of the floor duct and the location of junction boxes.

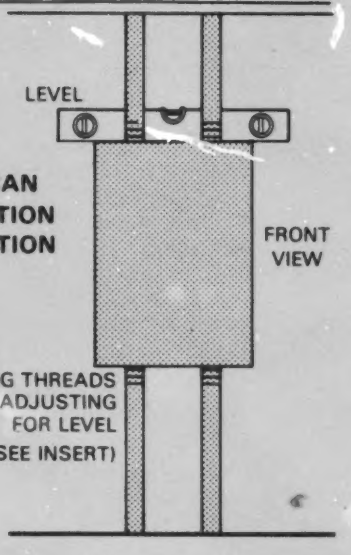
Once the floor duct system is laid out, it can be installed. Junction boxes should be placed at the proper locations. Interconnecting ducts should be cut and fitted between junction boxes. All joints then should be sealed. Support brackets should be installed on ducts and the junction box and duct brackets should be adjusted to the proper height. Marker screws should be installed. Junction boxes, duct brackets and marker screws should be adjusted to their proper heights.

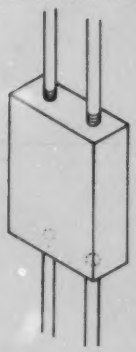
OUTLET BOX INSTALLATION ILLUSTRATION

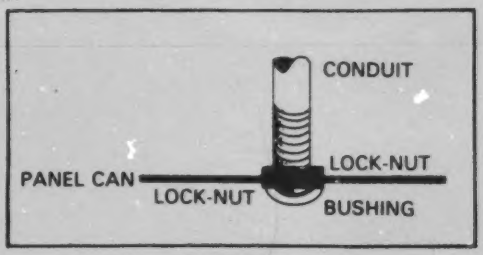


PANEL CAN INSTALLATION ILLUSTRATION









INSTALLING CONDUIT IN WALLS

Electricians also install conduit in drywall and masonry wall constructions. One task in doing this is to install outlet boxes on conduit stubbed up from a concrete floor. The first thing the electrician does is to measure and strike off the wall line, with a chalkline. Then conduit stubs should be adjusted with conduit hickeys. The type and height of the outlet should be located in the electrical plans. Conduit nipples should be measured, cut and installed. Conduit stubs should be adjusted to flush the box with the finished wall. The box should be leveled with a plumb bob and adjusted.

Besides outlet boxes, panel cans are also installed on conduit stubs. Once more the electrician will check the building plans and determine exactly where the panel cans should be installed. Conduit size and location should be marked on the panel can. Holes of precise size should be cut at measured locations in the top and bottom of the panel can. Conduit should be measured, cut and bent so that the conduit stubs can be extended to the proper openings in the panel can. Rigid conduit is threaded with extra long threads. Locknuts should be installed on the threads; then, the panel can should be mounted on the stub extensions. The can should be leveled by adjusting the locknuts. Inner locknuts and bushings should be installed. Last, the panel can should be leveled and set flush with the wall line.

PREFABRICATING OUTLET BOXES

Where masonry walls are to be installed, the electrician will often prefabricate outlet boxes and conduit for later installation. The first step is to sketch the conduit run. The necessary bends in the conduit should then be made. A wall section showing conduit and its bends should be drawn full scale on the floor, and the bends in the conduit should be compared to the bends in the floor. The lengths of conduit should be tagged.

Conduit and outlets are also installed in drywall construction. Once again the electrician checks the plans and finds the type and location of the outlets. Then the outlet location should be marked on wood or steel studs. Outlet boxes should be attached to the headers after the headers are installed between the studs. The conduit should be measured, cut and bent to fit the location. The conduit should be attached to the outlet box and anchored to the framing with conduit straps. The protruded section of the box should be measured to make sure that it will be flush with the wallboard.

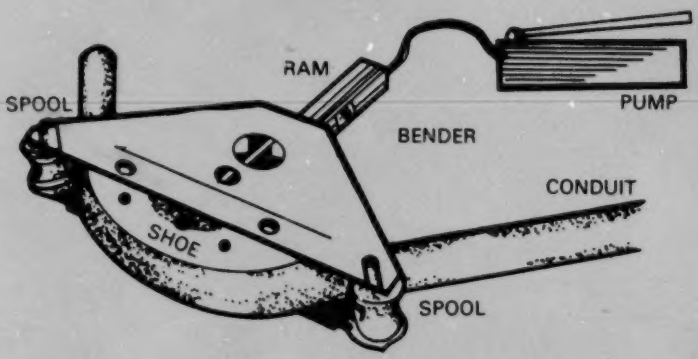
INSTALLING CONDUIT IN LATH AND PLASTER

Electricians also install conduit, outlets and fixtures in lath and plaster and suspended lift-out ceilings. In installing conduit and plaster rings in a lath and plaster ceiling, a length of flexible conduit — four feet or less — is installed and connected to the nearest junction box. The lath should be marked, using a fixture ring as template. A circular section of metal lath is cut out. The plaster ring then should be fastened to the lath and the flexible conduit attached to the fixture.

Electricians also hang lighting fixtures in suspended lift-out ceilings. As always, the electrician first checks the plans and locates the position of lighting fixtures. The spots where junction boxes should be placed are also located. The junction box should be anchored to the rough ceiling, and conduit installed and attached to the junction box. The lighting fixture should be hung on channels of the ceiling grid. Finally, flexible conduit should be run from the junction box to the fixture.

USING CONDUIT BENDERS

Conduit is bent not only by hickey benders but also by hydraulic benders. In practice exercises, an electrician learns to operate a bender by making a 90° bend and an offset bend. Here is an illustration of a hydraulic bender.



The electrician first must assemble the bender and get it set up to bend the conduit. The bending spools of the conduit bender should be set in place. The distance they are placed apart is determined by the size of conduit to be bent. The spool should be held in place with pins. Then the cylinder should be placed between the support plates. The cylinder pins should then be installed. The pin shoe support should be attached to the plunger, and the pin

shoe should be attached to the shoe support. Next the pump hose should be attached. Finally, the operation of the pump and plunger should be checked.

Once the bender is set up, the electrician should practice by making 90° bends and offsets in rigid conduit. Let's see how this is to be done. When a 90° bend is to be made, the electrician measures the length of the riser needed, and this length is marked off on the conduit. The conduit is placed in the bender; the mark is placed on the center of the shoe. Spools are placed in position. The bender is pumped until the bend is slightly less than 90°. The bender then is turned so that the riser leg is vertical. The lower leg is stretched out horizontally and checked with a protractor as the bender is slowly pumped. One extra degree of bend is added to allow for springback when it is released. The conduit should be released slowly. Then the conduit is remeasured. If the bend is still less than 90°, more bending should be done. The plunger should be released to return to its rest position and spool pins and spools removed. The conduit is broken loose from the shoe by rapping it sharply with a wooden block. The bend should be remeasured with a protractor to be sure that it is exactly 90°.

An offset bend may be made in conduit similar to making a 90° bend. The first thing the electrician does is to make a drawing of the offset showing where each bend will be made and exactly what angle each will have. Then the conduit should be measured between the centers of each of the bends, and the center of each bend should be marked. The first bend should be made and measured with a protractor. The conduit should be removed and placed in position for the next bend. The lengths of bend should be measured, and each angle should be measured with a protractor.

OTHER COMMERCIAL WIRING INSTALLATIONS

Commercial wiring has several distinct features not found in residential wiring. In commercial buildings electricians install service entrance equipment, lighting equipment, the cooling tower and cold storage vaults. The wiring method is always conduit.

Let's see how service entrance equipment would be mounted. First, as with any other piece of electrical equipment, the electrician studies the diagrams and designs showing how it is to be wired and where it is to be placed. The location of the equipment is measured and marked off on the floor and wall. Once this has been done, the current transformer can be mounted. The meter cabinet is then put up. Next to this the disconnect switch is installed. The distribution panel is then put in place. Conduit size is determined from the electrical plans.

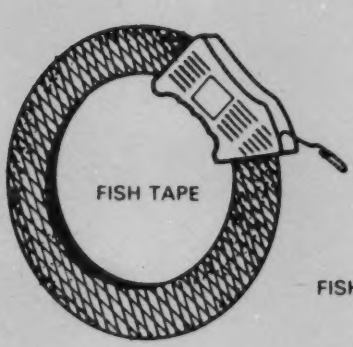
Once the panels and major components of the service entrance equipment have been installed, the electrician is ready to install the wire and to connect the service entrance equipment. The electrician measures and cuts wires to the proper length. After this is determined, the location of the line and load terminals on transformers and switch gear is made. Wires are identified by color code. The size, number and length of wires for each run are measured and listed. Wires are pulled into the conduit. Tails of wire are left inside the cabinet. Wires and their terminals are identified and connected to the proper terminals. The system ground and finally, the weather-head are installed.

SUBFEEDER INSTALLATION

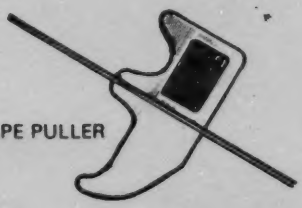
Electricians also carry a subfeeder from a distribution panel, through a crawl space, to a branch-circuit panel. A subfeeder carries current from the main circuit breaker at the entrance of a building to a small distribution panel. From the distribution panel, current is parceled out to a series of smaller circuits. The first step is to calculate the amperage which will be carried by the wire. Next, the size cable required and the most economical route for the cable is calculated. Conduit should be carefully measured, cut and bent. It should be supported by conduit hangers. The size and length of wire needed should be calculated, cut and pulled through the conduit. Circuit breakers or fuses should be located and installed to protect the branch circuit panel. Finally, the feeder wires should be formed and installed.

INSTALLING WIRES

Wires are installed by being pulled through conduit. Let's see how this is done. After the conduit has been cut, bent and installed, the electrician is ready to begin pulling wire through the conduit.



FISH TAPE WITH HOOK



FISH TAPE PULLER

The size of the wire to be installed has been determined. Reels of wire of the size required should be set in place so that an entire run of wire may be made without moving the reels. The wire is pulled through the conduit by a device called a fish tape. Fish tape is flexible steel tape which is made in 50, 100 and 200 foot lengths. It usually comes in 3 widths — 1/8, 3/16 and 1/4 inches. A hook and a leader are usually fastened to one or both ends of the tape. The tape is pushed into one end of the conduit. When it reaches the other end of the conduit the end of wire is attached to it. Then the tape and wire are pulled back up through the conduit.

INSTALLING PANELS

After conduit has been installed and wire run through it, the electrician then can install the branch circuit panel interior, circuit breakers and branch-circuit conductors. First, the panel interior should be installed. Next, the circuit breakers should be put in. The wiring should be stripped 1-1/2 to 2 inches with pliers and attached to the circuit breakers following the directions laid out in the layout sheets.

Commercial electricians install a variety of fluorescent and incandescent lighting fixtures which are similar, though often larger, than those used in residences.

CONDUIT FOR AIR CONDITIONING

When making conduit layouts for cooling towers of commercial air conditioning systems, in order to calculate the size of wire needed, the electrician should determine the voltage, phase and current requirements of the pump motor. As listed on its data plate, the National Electrical Code has a table which allows conversions from current and phase requirements to wire and conduit size.

After the calculations have been made, the electrician will then wire the motor starter into the power panel. The conduit should be cut, bent and attached properly. The conduit should then be run to outside walls and into a trench outside the building. Flexible conduit should be run from this line to the motor junction box and to the float switch junction box. Once the wiring and conduit are in place, the electrician then can install a pump motor and controls. Wires of a wide variety of colors should be chosen so that different wires may be identified easily. The wire should be pulled through the conduit with fish tape. The terminals on the relay should be identified. These include the load, line and control wiring terminals. The feed wires should be attached to the line terminals, and the motor wires should be attached to the load

terminals. Float switch wires should be connected to the control terminals. Motor feed wires should be connected to motor leads. Control wires should be connected to the float switch. The motor feed circuit should be connected to the proper circuit breakers in the panel. The electrician should locate the correct direction of rotation of the pump and should check the motor to make sure it rotates that way.

INSTALLING COLD STORAGE VAULT WIRING

Electricians also install cold storage vaults. Different types of cold storage equipment have different types of wiring systems. For this reason, the electrician should check the wiring diagram and directions provided by the manufacturer. The vault should be sketched and the locations of the equipment should be drawn in. The size of conduit and the size and number of wires should be noted. Conduit installed from outside the vault must be vapor sealed where it enters the vault. The conduit should be installed to the thermostat, lights, evaporator fan motor, liquid solenoid valve, defroster unit and timer unit. The wiring should be connected by following the diagram carefully.

These are the major tasks electricians working on commercial buildings perform. Although they are similar to the tasks electricians perform on residential buildings, they are somewhat more complex.

INDUSTRIAL WIRING

INTRODUCTION

Industrial plants take raw or semi-finished products and process them into finished or semi-finished products. They may vary in size from small metal-fabricating shops to huge steel rolling mills and petro-chemical plants. An electrician engaged in the installation and maintenance of industrial electrical equipment encounters many of the same materials and tasks that are utilized in residential and commercial electrical installations. Industrial electrical equipment is normally far more rugged and versatile than competitive grade counter-parts found in residential and commercial wiring.

The industrial electrician works with motors from one horsepower up to the 12,000 horsepower. These motors employ protective controls and backup systems that require the knowledge and skills of experts in the electrical field. These systems consist of many types of relays such as potential relays, current relays, magnetic-latch relays and solid state silicon control relays or thyristors. They employ many inductive devices such as transformers, induction coils and saturable-reactors.

To perform his tasks, the industrial electrician must achieve perfection in reading schematic diagrams and possess a thorough knowledge of the mechanical function of each piece of equipment that he is required to service. His duties require the installation and connection at power, distribution and control transformers that involve voltages from 24 to 138,000 volts. He must be thoroughly familiar with series and parallel connections, wye and delta connections, boosting and bucking connections and various combinations of phase-shifting connections.

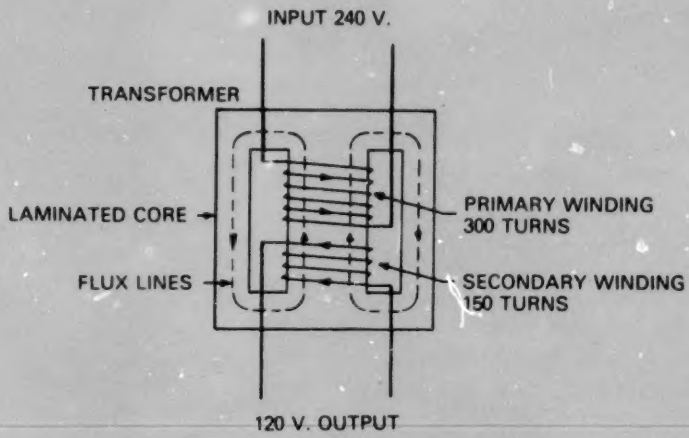
TRANSFORMERS

A transformer, basically, consists of two coils of magnet wire wrapped in a laminated iron core. When one coil (the primary coil) is excited or energized with alternating current, the core becomes magnetized. The cores magnetic field rises, falls and reverses polarity in sequence with the rise, fall and polarity reversal of the excitation voltage in the primary coil. This pulsing, reversing magnetic field, induces a pulsing, reversing current to flow in the second or secondary coil of the transformer.

The value of the voltage induced in the secondary coil will depend on the value of the excitation voltage and the ampere-turns ratio between the primary and secondary coils. For example, if the primary coil contained 100 turns of wire and the secondary coil

contained 50 turns of wire, then the ratio would be 100 ÷ 50 = 2 to 1 ratio. So if you excited the primary with 100 volts, then the secondary voltage would be 100 ÷ 2 = 50 volts.

When the transformer is supplying power to a load, the watts of power flowing in the secondary is nearly the same as the watts in the secondary coil, but the amperes will be different. In a 2 to 1 step down transformer, the amperes of current in the secondary coil will have to be two times as high as the amperes flowing in the primary coil. In other words, higher voltage delivers power with lower amperes and lower voltage delivers the same power with higher amperes of current flow.



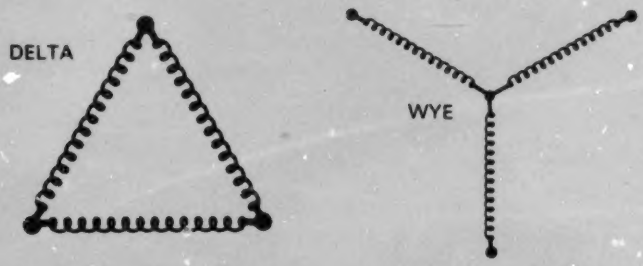
GENERATORS

All generators generate alternating current. A generator consists of a coil of wire rotating in the magnetic field between two opposite polarity magnets. As the coil revolves, it's wires cut magnetic lines of force. This induces current flow in the coil, first in one direction and then the other. The generator just described is a simple-phase generator, because it generates a single voltage and current. It is alternating because the current flows back and forth as the coil passes magnets of opposite polarity.

Large industrial type motors invariably use three-phase current. A three-phase generator consists of 3, single-phase generators, mounted on the same shaft, with their coils set to cut the magnetic lines of force at different times (1200 angles). This simply means that a three-phase power source delivers its pulses of power to a motor 3 times as often as a single-phase power

source, resulting in smoother performance. A comparision would be like the power delivered by a six cylinder engine as compared to the power delivered by a 2 cylinder engine.

Three-phase equipment is connected in two basic configurations, the "Delta" and the "Wye". These configurations get their names by the figure formed by their coils when connected. For example, coils connected this way form the Greek letter "Delta". Coils connected this way form the letter "Wye Y".



VOLTAGE TESTS

Industrial electrical equipment often operates on very high voltages. The wire and cable carrying these voltages must be insulated to contain these voltages with minimum current leakage.

The electricians' job often entails the periodic testing of the conductors insulation, especially if it has been out of use or subjected to excessive heat or moisture. The testing is accomplished with a high voltage ohm-meter, called a meg-ohm-meter or a high potential tester (hi-pot). One test lead is connected to one end of the coil in a transformer, motor or high voltage cable (after making sure the opposite end is clear from ground). The other test lead is connected to a grounded surface. The machine is turned on and the amount of current leaking out through the insulation to ground is registered on the meter. A chart or table on the tester designates the maximum allowable safe leakage for different voltage conductors.

Industrial type motors are usually fed from 440 volt power supplies. These motors are controlled by a multitude of push buttons, limit switches, pressure switches, etc. located all over the plant. High voltage is dangerous and difficult to keep insulated against leakage. For this reason, the voltage used to activate the relays that control the motors is usually held to a maximum of 115 volts. To reduce the 440 volt operating voltages to a safer 115 volts, a device known as a control transformer is used. This device steps the voltage down from 440 volts to 115 volts. These transformers usually have two primary coils and two secondary coils which

allows them to be used for reducing two primary voltages, 440 or 220, to two secondary voltages, 220 volts or 115 volts. A diagram on the transformers cover illustrates the wires to be connected for the various combinations.

Transformers used for distributing power from the primary distribution system to the individual buildings are called distribution transformers. These transformers usually operate with 13,000 volts on the primary and 440/277 volts or 320/115 volts on the secondary.

The type load to be served dictates the type transformer connection to be used. Before connecting, the primary voltage is first ascertained, and the load demand determined. The fused air switches are opened, using a hot stick.

Connecting for single-phase use, only one transformer is used. The primary will be connected either across the line, or from line to ground, depending on the line voltage and the transformers primary voltage reading. The secondary will be connected to a fuse solid neutral safety switch. The air switches will be closed with a hot stick and the secondary voltages read to determine correct voltages and connections. To connect for three-phase power, all 3 transformers will be used. The air switches will be opened. The primary coils will be connected in wye or delta, as the primary supply voltage and the transformer primary voltage ratings dictate. The secondarys will be connected in wye to a 3 fuse, solid neutral safety switch. The air switches are closed and the secondary voltages read at the safety switch. For connecting the secondarys in 4 wire delta, the air switches will be opened. The secondary coils will be connected in delta to two safety switches. Line #1, Line #2 and the neutral will be connected to the 2 fuse solid neutral safety switch. Line #1, Line #2 and Line #3 will be connected to a 3 fuse (no neutral) safety switch. The air switches will be closed. The voltages will be read on the 2 fuse solid neutral switch. The voltages will be read on the 3 fuse safety switch. To demonstrate the necessity of using separate switches, the voltage will be read from the neutral on one switch to L-3 on the other switch. The unuseable high-leg voltage of 190 volts will be noted between these two lines.

CAPACITORS

One of the electrical components found in industrial plants is a device known as a capacitor. A capacitor is just two conductors separated by an insulator called a dielectric. This device can store an electrical charge; it can halt the flow of direct current while it passes on the pulsing effect of alternating current. It can also be

used for correcting lagging power-factor, because it causes the current pulses to lead the voltage pulses by 90° at angle. This characteristic is used for starting split-phase, single-phase motors, by shooting current through the starting coil 90° ahead of the current flowing through the run coil, thus giving it a strong starting boost torque. These are called start conductors and are used only momentarily for starting the motor. Capacitors used as running capacitors, help reduce the current consumption of the motor by correcting the lagging power factor created by the inductive reactance of the motor. A capacitor size is measured in units called Farads. However, a farad is such a huge unit of capacitance that all capacitors are measured in units of 1 millionth of a farad or micro-farad.

A device called a potentiometer is also widely used in industrial control equipment. It is basically, nothing more than a variable resistance. It is used for varying the voltage of other devices, such as controlling the field excitation on separately excited generators, amplidynes, ro-to-trols etc.

RECTIFIERS

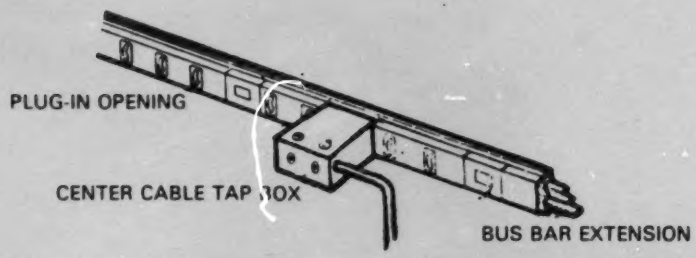
Many hoists and cranes used in industrial plants operate on direct current, because it provides precise speed control. To obtain direct current from alternating current, a device known as a rectifier must be employed. A rectifier allows current to pass in one direction, but not the other. A half-wave rectifier passes current only one half the time; a full-wave rectifier allows current to pass through the circuit 100 percent of the time.

DIODES

Selenium and solid state diodes are satisfactory for supplying small amounts of direct current, but the massive amounts required by cranes, hoists and aluminum reduction plants, require the use of mercury-arc and thyratron tube-type rectifiers.

BUS DUCT WIRING SYSTEMS

Industrial electricians install, connect, test, operate and correct malfunctions in explosion proof and bus duct wiring systems. First, let's see how a bus duct wiring system is installed. Bus ducts are used in industrial plants where the location of the machinery installed is so varied that it is impractical to run wiring beneath the floor. Busways carry current overhead on bare copper or aluminum bars. They are held up on insulated sheet metal. When an electrician installs a bus duct system, the first thing done is to assemble a bus duct section. This section is then mounted on the wall or ceiling of the shop. Conduit is measured,



cut, fitted and installed from the bus duct junction box to the power distribution panel. The second section is attached to the first section. The dead end plate is then installed. Finally, the wire is pulled from the main power panel to the bus duct junction box. The wire is fastened to bus lugs and connected to power panel breakers. The bus duct switch nearest the machine to be wired up is then opened, and the conduit and wire is connected to the machine. The bus duct switch is fused. The breakers and switch are closed and the machine is tested.

EXPLOSION PROOF WIRING SYSTEMS

Electricians also install explosion proof wiring systems. These are installed in locations where the atmosphere is filled with gases, vapors or dust which are very explosive and which might be set off by even a slight spark or overheating. Explosion proof fittings, fixtures and conduits are manufactured by several companies. The directions provided along with these fixtures should be followed closely. All explosion proof systems enclose all wiring and all contact points between wires in sealed containers.

MOTOR RELAYS

Electricians also work on motor relays. They connect and test the parts of a motor relay system. Once the parts of this system are connected, the electrician must also be able to detect malfunctions in the system. In order to connect the parts of a motor relay system, the electrician must be able to identify its basic parts and to adjust them. Let's see what relay systems are and what they do. They are used to switch loads in small circuits. Relays are part of the control system which controls small motors, electric heaters, pilot lights and so on. Usually, they are wired into two wire circuits. Relays are available in single and double constructions. Relay work somewhat like switches, in that they open and close circuits. Some relays are operated manually; others are

automatic and rely upon the electromagnets, the pull of gravity or springs to operate them. Relays vary widely from manufacturer to manufacturer. However, the major problem in installing relays lies in adjusting the contact points so that they are held at proper distance (contact and core gap) from one another. Further, the two points and the plates of the points, should make exact contact, so that one plate exactly covers the other. Once the points have been adjusted, the relay can be wired to the control switch. A motor then should be connected to the relay and tested. This type of relay is called a line voltage relay. This relay uses straight 115 or 230 volt current rather than current generated by a motor reaching synchronous speed (potential relay).

Time delay relays allow a period of time to pass between the time a switch is opened and the relay actually closes the circuit. There are two main types of time delay relays. One is operated with an electromagnet; the other with a charged capacitor. In either case, current builds up slowly in the coil or the capacitor until a certain point is reached, at which time current flows and the relay is activated. When choosing a timed relay, the electrician should carefully consider the amount of delay which will be needed and the amount of allowable tolerance in the timing. The length of the cycle, and whether it is a repeating cycle or a one time cycle, should be taken into consideration.

Another type of relay used is a part-winding motor starting relay. Let's look at how this starting relay operates. First of all, large motors should start at a lower voltage than that at which they run. To prevent excessive voltage dip, only 1/2 the motor coils are energized while starting. Electricians need to know the varieties and types of electric motors. The main types of motors found in industrial installations are single-phase single voltage, single-phase dual voltage, three-phase single voltage, three-phase dual voltage and three-phase two-speed motors. Some of the different types of motors to be identified are shaded pole motors, split-phase motors, induction-repulsion motors, ac-dc universal motors, three-phase wound motors and three-phase synchronous motors.

A shaded pole motor is used in small appliances. Usually, it ranges from 1/100 to 1/8 horsepower. Inside there is a coil called an armature. There is a thick ring of copper, called a shading coil, which is wrapped around each pole. If the armature is turned around in its cage, its direction of rotation will be reversed.

Split-phase motors are also small motors; they range in size from 1/20 to 1-1/2 horsepower. They are normally used on relatively light loads — in washing machines, exhaust fans, etc. They generally operate on 115 and 230 volts. Frequently, they are built

into the machine they operate. Single-phase current is used on split-phase motors. The armature contains two windings. One is the starting winding; the other is the running winding.

An induction-repulsion motor uses less starting current than any other type of motor. At the same time, it has the greatest starting torque. For this reason, it is ideal for very heavy loads. The motor is set in motion by repulsion between identical poles on two electromagnets.

Universal motors start with a great deal of rotation. This is called torque. The size of these motors varies from 1/200 to 1 horsepower. A universal motor has a commutator (a device on the armature which runs on both alternating and direct current) and brushes.

Three-phase wound-rotor motors and three-phase synchronous motors both operate on three-phase current. Wound-rotor motors are used where the motor speed must be adjustable. The rotor for a wound-rotor motor has three separate windings placed 120° apart. The windings are connected to three slip rings on the rotor shaft. External resistances are used to control motor speed. Three-phase synchronous motors run at the same speed no matter what load they are under. They are built in much the same way that a three-phase ac generator is built; that is, the rotor, as it rotates, maintains an electromagnet which is powered from a separate dc power source. The main parts of a three phase synchronous motor are: Three separate windings in the starter (the hollow cylinder in which the armature rotates); the rotor (the rotating cylinder of the motor which has its own windings); the brushes and brush holders; the bearing housing to support the bearings on which the armature rotates. The best way to learn about each of these motors is to disassemble and then reassemble them.

CONNECTING WIRING ON MOTORS

As a step in learning to connect the wiring on motors, you might connect a single phase, single voltage motor. Such motors may be wired to rotate either clockwise or counterclockwise. The first thing to be done is to check the data plate on the motor for information on its horsepower, voltage, current, phases and RPM. The data plate should contain the wiring diagram. The path of the internal wiring should be noted. The motor then should be connected to the current, and you should note which direction the armature turns. The motor should then be turned off. The lead wires on the start winding should be reversed so that the motor will turn in the opposite direction.

Another operation is to connect a single-phase, dual voltage motor for high and low voltage and reverse rotation. Dual voltage motors will operate on either 115 or 230 volts. The starter coils are wired in parallel for low voltages and in series for high voltages. To reverse the rotation, the location of starting leads should be reversed. Three-phase single voltage motors very often must be connected for clockwise and counterclockwise rotations. Three-phase motors run more evenly, require less current for each horsepower delivered, and run longer with less maintenance costs than do single motors. Usually three-phase motors are connected by a star pattern of wiring. Once the motor is wired into the star pattern, it should be turned on and its direction of rotation should be noted. Then it should be reconnected, switching any two of the feed wires for opposite direction of rotation.

Three-phase dual voltage motors can also be connected in a star or Y pattern to either 220 or 440 volt systems. The difference between low and high voltage hookups is that low voltage connections must be in parallel; high voltage hookups must be in series.

Finally, and most complex, three-phase, two speed motors must be hooked up. Two different sets of starter windings are used for two speed motors — one for the low and one for the high. Motor manufacturers provide wiring diagrams for such motors. These diagrams are usually engraved on the data plate and should be followed exactly.

ELECTRICAL EQUIPMENT INSTALLATIONS

Electricians install and repair a wide variety of types of equipment in industry. This equipment includes air compressors, lighting, refrigeration equipment, pumps and exhaust fans. A typical task an industrial electrician might face would be installing a bank of lighting fixtures controlled by a push button and a mechanically held station. First, let's look at pushbuttons. Pushbuttons open

and close circuits by pressing buttons. Usually, the contact points are made of silver to reduce resistance. The electrician should first install fixture boxes according to blueprint. Then the magnetic contactor should be selected and installed. The pushbutton station should be installed. Conduit runs should be installed and wire should be run through the conduit. The wire should be attached to circuit breakers and contact terminals. The circuit wires should be attached to the lighting fixtures, and finally, the fixtures should be attached.

Another task is to install a motor with a reduced starting voltage and an autotransformer to run an air compressor. The first step is to examine the air compressor and determine exactly what type of motor and reduced voltage starter is required. The exact location of the motor, starter and START-STOP station should be noted. The motor starter and pushbutton station should first be installed. The conduit and the wiring should be roughed-in, and the wiring to the pushbutton station should be connected. Next, the control circuit to the starter should be connected. The power leads should be wired into the starter and the motor leads wired up to the power. The motor leads can then be connected to the circuit breaker in the panel board. Finally, relays should be installed in the circuit between the pushbutton and the motor starter.

Industrial electricians also wire lathes using bus duct systems. First, the electrician should examine the motor on the lathe to determine the size of circuit breakers needed, and the type of wiring and starter required. Plug in type circuit breakers should be used. A combination motor starter should be installed. Conduit should be roughed-in between the bus duct and the combination starter. The drum controller and the START-STOP pushbutton should be placed where the lathe operator can reach them with ease. Liquid-tight, flexible conduit should be used. Control wiring should be connected to the pushbutton station and the magnetic starter. Then power leads should be connected to the motor. Wiring between the starter and the plug-in circuit breaker should be pulled through the conduit. Power leads should be connected to the circuit breaker. The circuit breaker should be installed.

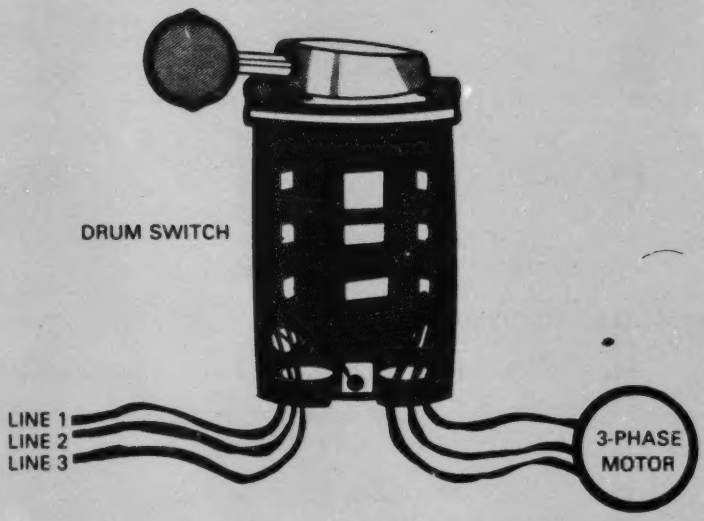
Another example of an industrial electrical project would be the installation of an induction motor and exhaust fan in a garage. The first step is to check plans and blueprints to determine where the fan should be located. Then the conduit and boxes needed should be roughed-in. Wiring should be pulled through the conduit with a fish tape. A time clock then should be wired in, and it should be set for the proper time cycle. The flow switch and the temperature switch should be wired next. The power and control circuits should be wired to the magnetic starter on the fan.

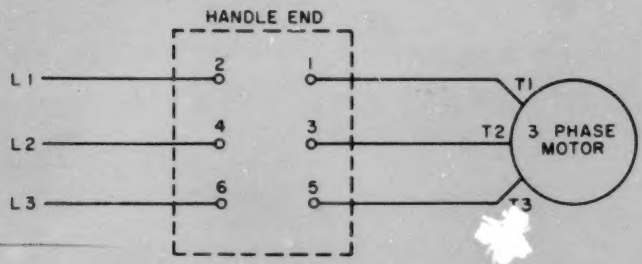
An overcurrent relay should be installed. Then the power leads should be wired to the motor. The louver should be installed and leads should be wired to the louver motor. The circuit should then be wired to a proper sized circuit breaker. Last, the current should be turned on and the operation of the fan checked.

Electricians frequently install the electrical systems for cold storage plants. Once again, the steps in installing it include roughing-in the conduit and boxes. Then the proper sized conductors should be pulled through the conduit. The selector switch for AUTO-OFF-MANUAL should be installed. A step down transformer should be connected to the line, and a magnetic starter should be attached to the motor. A low voltage relay should be wired in. A low voltage thermostat goes in next. Power leads should be wired to a properly chosen circuit breaker. Finally, the current should be turned on and the system checked out.

Another job for electricians is to install pumps driven by electric motors. The first step is to determine what circuit requirements are specified for the motor. This information can be calculated from the motor name plate data. The circuit should be planned and laid out. Motor and pump assembly should be mounted. Conduit and wiring should be roughed-in. The pressure switch should be attached and the wiring connected. Motor terminals should be located and connected. The pump shaft should be rotated manually to check for locked bearings. Power should be turned on and the machinery checked for correct direction of rotation.

Industrial electricians also install and test various pilot control devices. These devices may be manually operated, temperature operated, liquid level, pressure sensitive, flow actuated or light sensing. First, let's see how manually operated pilot devices would be installed to operate starters and motors. There are several different types of manually controlled pilot devices for starters and motors. There are circuits for controlling motors from one or two stations. Drum switches may be used to run a motor either forward, reverse or to shut off. Most control switches use three wires in the control. One device which is used to reverse the direction of rotation on three-phase motors is called a drum switch. Still other control devices are temperature sensitive. These are called thermostats and come in a wide variety of types and styles. Usually, they contain two strips of a dissimilar metal fastened together. The different metals expand and contract at different rates as the temperature changes. This means that the strip is always warped into some sort of curve. It is then adjusted so that at certain temperatures it will close a circuit and start a motor.





CONTACT	FORWARD	OFF	REVERSE
1-2	X		
3-4	X		
5-6	X		X
1-4			X
2-3			X

X = CONTACTS CLOSED

Liquid level pilot devices are very often used with pumps of one type or another. They are designed to turn a pump motor on when the level of liquid in a tank drops to a certain level, or to turn the pump off when the liquid level rises to a designated point. To install thermostats or liquid level control devices, manufacturer's instructions should be followed carefully. Other devices use air pressure, or the quantity of liquid flowing through a pipe as means of turning motors on or off. Still other devices rely on the presence or absence of light to control motors.

These, then, are some of the major tasks of industrial electricians.

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SAFETY

WORK AREA SAFETY

Electrical personnel should make every attempt to keep the work area at the construction site or electrical repair shop free of materials and debris. Grease, oil, water or similar types of material on the floor can create hazards which can cause serious injuries. In addition, loose fittings, wire or conduit ends or other debris stored or thrown at random on the floor areas in or around the job site can cause personal injury. Development of good housekeeping by electrical personnel has an additional advantage of establishing good work habits that are carried over into the installation of wiring.

All tools and equipment should be maintained in good operating condition. Improperly operating equipment should never be used in wiring practice. Tool handles should be inspected periodically for correct position to the working surface and checked to make sure they are tight. All handles should be insulated against shock hazard. Drills, chisels, saws and other cutting tools and equipment should be kept sharp. Workbench surfaces and surrounding floor areas should be covered with rubber insulation.

ELECTRICAL INSTALLATION

One of the most common operations of electrical personnel is wire stripping. This can be done either with a tool designed for this purpose or with an electricians knife. When knives are used, cutting should be directed away from the body or other personnel to prevent accidental injury.

All ladders used by electricians should be well constructed, kept in good repair and never painted. For safety, a ladder should be anchored to the building with a rope or chain or placed against a projection on the supporting surface. If it cannot be secured in any of these ways, the electrician should use a helper at the base of the ladder. The distance between the base of the ladder and the vertical surface against which it is supported should be approximately one-quarter the length of the ladder. Caution should be used with aluminum or other metal ladders so that they do not come in contact with live circuits or exposed wires.

When the wiring location is inaccessible from normal work areas and the installation is large or complex, scaffolds rather than ladders should be used as overhead work platforms. All scaffolds should be sturdy, well-built and securely anchored and cross-braced. The scaffold planking should be free of knots, checks and cross-grained sections. Planks used for scaffolding should be

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load-tested periodically with up to three times their work load. They should not be used if failure or weakness shows up in the test.

Whenever possible, all electrical installation work should be done on a de-energized (dead) circuit. The method preferred by the majority of electricians is to trip the main service-entrance switch and remove the fuses. In addition, the switch should be tagged. The tags should give the electrician's name, the date and the time the switch was turned off. If existing conditions do not permit this procedure, the circuit being repaired or modified should be de-energized. This is done either by removing the branch circuit fuses or tripping to OFF the circuit breaker connected to the branch circuits.

The practice of working on "hot" circuits is not recommended. When required, only experienced personnel should be assigned to work on hot or energized circuits. Remember, alternating-current voltages as low as 67 volts and direct-current voltages as low as 110 volts have caused death by electrocution. When an electrician has to work on a hot line, the following procedures should be closely followed:

- Insulate body from becoming a conductor path for the current flow.
- Work on only one side of the circuit at a time.
- Always use insulating gloves and stand on non-conducting materials.
- All equipment, tools and wearing apparel should be dry. Dry materials offer more resistance to the flow of electricity than wet items.

Although an electrician may have de-energized a circuit by pulling the main switch, removing a circuit fuse or tripping a local switch, it is imperative that the circuit be rechecked with an instrument such as a test lamp or voltmeter before starting work. The voltage rating of the test lamp should be twice the estimated voltage of the circuit under test. A series combination of test lamps, each rated at the estimated voltage, will also serve this purpose. This is done by placing the test prods of the instrument on the hot and neutral circuit wires at the fuse, circuit breaker panel, or outlet box where the work is to be done. Never attempt to modify or repair an existing circuit until this test is made. Under no circumstances should circuits be tested with the fingers or with tools.

On equipment, or in wiring systems where wires are numerous and circuit identification difficult, wire markers are an aid to installation. However, they should be used only as a guide, and

the electrician should carefully check the condition of each conductor with a test lamp or voltmeter before working on the circuit. This safety rule also applies to wires that are color coded to conform with the prescribed circuit or equipment-ground requirements.

OPERATIONAL SAFETY

Fuses or circuit breakers are installed as overload and short circuit protection for circuit components and connected loads. Their selection with regard to ampere rating must be limited to the maximum value allowable for the smallest conductor or equipment used in the circuit. For example, if an electrical device has a 15-ampere fusible rating and it is connected to a circuit wired with number 12 gage conductors rated at 20 amperes, the fusing of the circuit should be 15 amperes.

Frequently blown fuses or tripped circuit breakers indicate short circuits, grounding or circuit overloads. The problem should not be solved merely by installing larger fuses than those recommended for use in the circuit. This action exposes both the building and personnel to an electrical fire. First the cause of trouble must be determined. Overloaded circuits should be rewired by increasing the wire size of the run or by dividing the connected load into several circuits.

Under no circumstances should the fuse or circuit breaker protection be bypassed by jumpers or removed from the circuit, except when testing for short circuits. These primary safety devices are of vital importance in a circuit installation. If they are bypassed, the electrical installation loses its circuit-current limitation and short circuit protection. If the devices are removed, the troubles that caused the power interruption or circuit failure will not be isolated to the local circuit. It will cause the rest of the fuses to blow or the circuit breakers to operate, cutting off the entire system from power.

ELECTRICAL SHOCK

Human failures that can lead to electrical shock are:

- Failure to observe the necessary safety precautions when using or working on equipment that would be perfectly safe if handled properly. A careless electrician might fail to test equipment to make sure that it is de-energized before working on it.
- Making unauthorized modifications to equipment or using unauthorized equipment.
- Failure to make adequate repairs on equipment that has already caused nonfatal shocks.
- Failure to test the insulation resistance and the completion of the ground connection after the equipment has been repaired.

Human failure is prevalent, because people often take a casual attitude toward the deadly potentials of electric circuits and equipment. Two conditions must be satisfied for current to flow through a person:

- The person must form part of a closed circuit in which current can flow.
- Somewhere in the closed circuit there must be an electromotive force or a difference in potential to cause current flow.

To guard against electrical shock a person should see that the body never forms part of a closed circuit through which current can flow.

AFTER GRADUATION

GOING TO WORK

Toward the end of your senior year you will need to make a decision as to whether you want to seek additional training in some phase of electrical wiring or go directly to work. Even though you probably know your capabilities, you might want to discuss your next move with your instructor and vocational counselor.

If you decide to go directly to work, you will need to ask yourself several questions. Where do I want to locate? What kind of company do I want to work for? What type of working conditions do I desire? As much as possible, know what you want in going to work. Use this information as a goal, and set your mind to achieve it.

Most construction electricians work for electrical contractors. Substantial numbers are self-employed. Others work for government agencies or business establishments that do their own electrical work. Construction electricians usually work for a large number of different employers during their lives because of the intermittent needs of contractors. However, many construction electricians work for the same electrical contractor for long periods of time. During a single year, a construction electrician may work for an electrical contractor in the construction of new homes or office buildings; for a manufacturing firm in remodeling its plant or offices; do electrical repairs for homeowners or business firms.

An experienced construction electrician can transfer readily to other types of electrical work. For example, many take jobs as maintenance electricians in factories or in commercial establishments; others work as electricians in shipbuilding and aircraft manufacturing.

The work of the construction electrician, like that of other building trades, is active but does not require great physical strength. Frequently the construction electrician stands for prolonged periods; sometimes the work is in cramped quarters. Because most of work is indoors, the construction electrician is less exposed to unfavorable weather conditions than most other skilled building trades workers. Electricians risk falls from ladders and scaffolds, cuts from sharp tools, electrical shock, blows from falling objects, and burns from "live" wires. However, safety practices learned during apprenticeship and other types of training have helped to reduce the injury rate for these workers.

Because improperly installed electrical work is hazardous, most cities require electricians to be licensed. To obtain a license, the electrician must pass an examination which requires a thorough knowledge of the craft and of State and local building codes.

Hourly wage rates of construction electricians are among the highest in the skilled building trades. Furthermore, because the seasonal nature of construction work affects electricians less than most other construction workers, their annual earnings generally are among the highest.

A large proportion of construction electricians are members of the International Brotherhood of Electrical Workers.

Many journeymen electricians become superintendents for electrical contractors on construction jobs. These people may also become estimators for electrical contractors, computing material requirements and labor costs.

Many construction electricians go into business for themselves. As they expand their activities, they may employ other workers and become contractors. In most large urban areas, a master electrician's license is required to engage in an electrical contracting business.

MORE EDUCATION

Most training authorities, including the National Joint Apprenticeship and Training Committee for the Electrical Industry, recommends the completion of a 4-year apprenticeship program as the best way to learn all aspects of the electrical trade. However, in the past some construction electricians have acquired skills of the trade informally by working for many years as helpers, observing or being taught by experienced people. Many of these persons

have gained additional knowledge of the trade by taking trade school or correspondence courses, or through special training when in the Armed Forces. Special training programs developed by the federal government in recent years have created another source of training in electrical wiring and maintenance.

The International Brotherhood of Electrical Workers and the National Electrical Contractors Association have jointly developed an extensive apprenticeship program. Apprenticeship applicants generally are required to be between 18 and 24, but exceptions may be made for veterans. A high school education is required; courses in mathematics and physics are desirable. Applicants are usually required to take tests to determine their aptitude for the trade.

The apprenticeship program usually requires 8,000 hours (4 years) of on-the-job training, in addition to a minimum of 144 hours of related classroom instruction each year. In a typical 4-year training program, the apprentice learns, among other things, to use, care for and handle safely the tools, equipment and materials commonly used in the trade; to do residential, commercial and industrial electrical installations; to maintain and repair installations. In addition, related classroom instruction in subjects such as electrical layout, blueprint reading, mathematics and electrical theory are given. After completing their apprenticeship, many journeymen electricians enroll in courses, which may include advanced electronics, to keep abreast of the latest developments in this rapidly changing occupation.

Hourly wage rates of apprentices usually start at 40 to 50 percent of the journeyman rate and increase by 5 percent in each 6-month period until 80 to 85 percent of the journeyman rate is reached during the last period of the apprenticeship.

GLOSSARY

Accessible—not permanently closed in by the structure or finish of the building. Capable of being removed without disturbing the building structure or finish.

A.C. Alternating Current— a current of electrons that move in one direction and then another alternating 60 times a second.

Alternator—an alternating current generator.

Ammeter—a meter used for measuring current.

Ampacity—current carrying capacity expressed in amperes.

Antenna—a device used for sending or receiving radio waves.

Appliance—a mechanical unit which is installed to perform one or more functions such as a clothes washer, air conditioner, etc.

Appliance-fixed—an appliance fastened or otherwise secured at a specific location.

Appliance-portable—an appliance which is actually moved or can be easily moved from one place to another.

Appliance-stationary—an appliance which is not easily moved but can be moved if necessary.

Battery—several voltaic cells (wet or dry) connected in series or parallel, usually in a container.

Branch circuit—the portion of the wiring system extending beyond the final overcurrent device protecting the circuit.

Branch circuit light panel—takes the power from the main switch and feeds it to the light and receptacle circuits through separate circuit breakers or fuses.

B.T.U. -British Thermal Unit—the quantity of heat required to raise one pound of water one degree Fahrenheit.

BX cable—trade name applied to armored cable.

Capacitor—two metal plates separated by an insulator used to increase the capacitance to the desired level.

Charge—the process of sending an electric current through a storage battery to renew its action.

Circuit—the path of electron flow from the source to the load and back to the source.

Circuit breaker—a safety device which automatically opens a circuit if overloaded.

Concealed circuit—a circuit that is hidden by the structure or finish of the building.

Conductor—a material which permits free motion of a large number of electrons: e.g., copper and aluminum.

Conductor-bare—a conductor with no covering or insulation whatsoever.

Conductor-covered—a conductor with one or more layers of non-conducting material which is not recognized as insulation.

Conductor-insulated—covered with a recognized insulation.

Conduit—a metal pipe used to enclose electrical conductors.

Continuous load—a load where the maximum current is expected to continue for three or more hours.

Current—the rate at which electrons flow through a conductor; electrical volume.

D.C. -Direct Current—the flow of electrons in only one direction.

D.P. - Double Pole—having two contacts, such as a double pole switch.

Duplex receptacle—a double outlet receptacle used in house wiring.

Edison socket—a socket that accepts a light bulb with a screw-in base.

Electron—a negatively charged particle.

Electro-strip wall receptacle—an insulated strip where several receptacles are installed on the wall for convenience.

Floor duct—large square conduit that is buried under a concrete floor. It has receptacle outlets flush with the floor.

Fluorescent—a property of phosphorus which, under controlled conditions, radiates light when absorbing electrons.

Generator—a rotating electric machine that converts mechanical power into electrical energy.

Ground—a connection to earth which serves as a common return circuit.

Hickey—a tool used to bend metal pipe or conduit (commonly called pipe bender).

Insulator—a substance containing very few free electrons (a non-conductor); e.g., plastic, rubber.

Intercom—a term used to describe an audio communication system.

Junction box—a box in which connections of several wires are made.

Kilowatt—a common unit of measurement of electrical energy, equal to 1,000 watts.

Main disconnect switch—cuts off the power to the entire building. Its fuses will flow if a major short occurs, thus protecting the wiring.

Multimeter—a combination volt, ampere and ohm meter.

Neutron—a particle which is electrically neutral.

Office lights—usually fluorescent fixtures hung end to end so that the power feeds into the end fixtures and the wires are run from fixture to fixture in troughs or housings. This is also called trough wiring.

OHM—the unit of measurement for electrical resistance.

Outlet—a point on the wiring system at which current is taken to supply some type of electrically powered equipment.

Outline lighting—an arrangement of incandescent lamps or gaseous tubes used to outline or call attention to certain features such as the shape of a building or the decoration of a window.

Overload—a greater load applied to a circuit than it was designed to carry.

Paint room lights—paint rooms often have explosive fumes. This makes special explosive-proof conduit necessary to protect the conductors in case of a short. This type of conduit and its fittings are very expensive.

Parallel circuit—two or more paths for electrons to follow.

Pigtail—a flexible wire extending from a component for ease of connection.

Power distribution panel—takes the power from the main switch and feeds it to the utilization equipment through separate circuit breakers or fuses.

Proton—positively charged particle.

Range outlet—an electrical cook stove connection.

Receptacle—a contact device installed at an outlet for the connection of plug and flexible cord.

Resistance—the opposing of current through a circuit.

Run windings—those windings of large wire in an electric motor which are energized throughout the motor.

Schematic—a diagram of electronic circuits showing connections.

Series circuit—a circuit that contains only one possible path for electrons to follow.

Service—the conductors and equipment necessary for delivering electrical energy from the electrical source to the wiring system of the premises served.

Service cable—service conductors (wires) made into cables.

Service conductors—the supply conductors which extend from the main supply or transformer to the service equipment of the premises supplied.

Service drop—the overhead conductors from the utility pole connecting to the service entrance conductors at the building.

Service drop lines—carries power from the transformer to the building.

Service entrance—the equipment needed to bring power into the building.

Service feeders—carries power from the service drop to the meters.

Short circuit—a direct connection across the source of current.

Single phase—standard alternating current which phases from positive to negative in a sine curve at the rate of 60 times per second.

Single-pole switch—a switch which has open and closed positions only.

Start windings—those windings of smaller wire in an electric motor which are energized only to start the motor and which are turned off after the motor has achieved a set number of revolutions per minute.

System ground wire—grounds the entire conduit system so that a shorted or grounded hot wire will blow a fuse or breaker rather than electrifying the entire conduit system.

Three phase—alternating current with staggered phases of 120 degrees in a sine curve. Each operates similar to a single phase.

Three-way switch—a three screw switch in which the current may take either of two paths.

Transformers—utility pole mounted transformers take the power from the main distribution lines at 13,000V and reduce it to 115V and 230V so that it can be used to operate lights, motors, appliances, etc.

Voltage—electromotive forcing electrical pressure.

APPENDIX

RESIDENTIAL WIRING

How To Be Your Own Home Electrician by George Daniels, 1970 Popular Science Publishing Inc.
355 Lexington Avenue
New York, New York 10017
Dist. by Har-Row

All About House Wiring Simplified by Floyd Mix, 1973 Goodheart-Wilcox Company, Inc.
123 W. Taft Drive
South Holland, Illinois 60473

House Wiring by Roland Palmquist, 1971, sec. ed., Theodore Audel orders to Babbs-Merrill Co., Inc.
4300 W. 62nd Street
Indianapolis, Indiana 46268

Practical Electrical Wiring, Residential, Farm and Industrial by Herbert P. Richter, 1970, 8th Ed., McGraw-Hill Publishers
1221 Avenue of Americas
New York, New York 10036

Popular Mechanics Home Book of Electrical Wiring and Repair by Harold P. Strand, 1964, Published by Popular Mechanics Hawthorn Books, Inc.
70 Fifth Avenue
New York, New York 10011

INDUSTRIAL WIRING

Industrial and Commercial Wiring, by Kennard C. Graham (text 10-12), 2nd Edition, 1963
American Technical Society
848 E. 58th Street
Chicago, Illinois 60637

Electrical Installation and Regulations, by I.C. Whitfield, 1966 Pergamon Press, Inc.
Maxwell House, Fairview Park
Elssford, New York 10523

COMMERCIAL WIRING

Electrical Construction Wiring, by Walter N. Alerich, 1971 (text gr. 9-12) American Technical Society
848 E. 58th Street
Chicago, Illinois 60637

ADDITIONAL SOURCES OF INFORMATION

National Electric Reliability Council
Research Park, Terhune Road
Princeton, New Jersey 08540

Electrical Equipment Representatives Association
P.O. Box 999
Morro Bay, California 93442

International Association of Electrical Inspectors
802 Busse Highway
Park Ridge, Illinois 60068

National Electrical Contractors Association
7315 Wisconsin Avenue
Washington, D.C. 20014

National Electrical Manufacturers Association
155 East 44th Street
New York, New York 10017

Electric Energy Association
90 Park Avenue
New York, New York 10016

International Brotherhood of Electrical Workers
1125 15th Street N.W.
Washington, D.C. 20005

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ABSTRACT: THE PURPOSE OF THIS INSTRUCTOR'S GUIDE IS TO OUTLINE A SERIES OF TRAINING EXPERIENCES RELATED TO MASONRY THAT CAN LEAD A STUDENT TO AT LEAST ENTRY-LEVEL JOB PROFICIENCY. THE GUIDE IS DIVIDED INTO SEVERAL TEACHING UNITS, EACH WITH AN OVERALL OBJECTIVE. THERE ARE FURTHER DIVISIONS LISTING SUBOBJECTIVES WHICH, WHEN SUCCESSFULLY COMPLETED BY THE STUDENT, WILL SATISFY THE OVERALL OBJECTIVE FOR A SPECIFIC UNIT. SUGGESTED ACTIVITIES ARE LISTED UNDER THE SUBOBJECTIVES AND ARE SUPPORTED BY A NUMBER OF TEXTS. SOURCES OF INFORMATION AND AN OUTLINE OF "ACADEMIC RELATED THEORY AND INFORMATION" ARE ALSO INCLUDED IN EACH UNIT. UNIT TITLES FOR THIS GUIDE ARE: CONCRETE WORKING, BRICK AND BLOCK LAYING, PLASTERING, AND TILE AND TERRAZZO WORKING. APPENDED IS A SAMPLE LESSON PLAN. THIS DOCUMENT SHOULD BE USED IN CONJUNCTION WITH THE STUDENT MANUAL FOR MASONRY (VT 102 418 IN THIS ISSUE). (AUTHOR/LJ)

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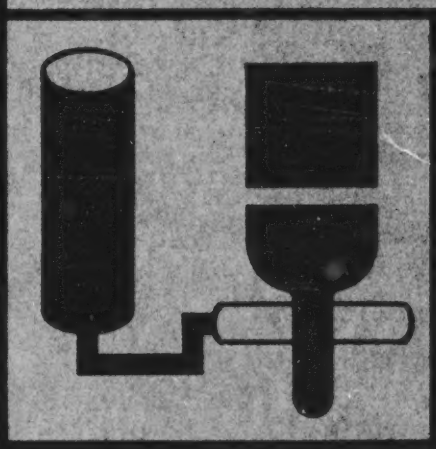
MASONRY



construction industry series
instructor's guide
preparation level

IT 1/2 417

2

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This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

EXPLORATION LEVEL:

Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

OCCUPATIONAL PREPARATION LEVEL:

Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
Metal - Student Manual
Metal - Instructor's Guide
Electricity - Student Manual
Electricity - Instructor's Guide
Masonry - Student Manual
Masonry - Instructor's Guide

In addition, there is an Articulation Guide designed for these instructional materials in construction.

Articulation Guide - Construction Industry Series

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INTRODUCTION TO MASONRY

OCCUPATIONAL PREPARATION

PURPOSE

The purpose of this guide is to outline a series of training experiences that can lead a student to at least entry-level job proficiency. The instructor guide is divided into several teaching units, each with an overall objective. There are further subdivisions listed as sub objectives which will satisfy the overall objective for a specific unit when successfully completed by the student. Suggested activities are listed under the sub objective and are supported by a number of texts.

Use of behavioral objective format may or may not be new to you. There are a few basic components which acceptable behavioral objectives must include. First, all behavioral objectives must be directed toward student performance. Second, they must clearly state action or behavior which a student must perform. Third, there must be some criteria by which you can measure the success or failure of that action or behavior.

The establishment of a series of measurable goals for each student can individualize the education and training process. If a student can demonstrate skill in certain basic tasks to the satisfaction of the instructor, the student can move on to tasks which are more challenging. Instructing all of your students in the performance of a task, in which many of them are already proficient, can severely affect enthusiasm and motivation. This problem can, in large part, be overcome by the use of a pretest designed to provide a beginning point from which the student can start his or her training. The systematic use of planned instructional outcomes (behavioral objectives) can serve to more effectively motivate students.

The instructor's guide makes no attempt to set down absolute standards defining successful student performance. It will be your responsibility to establish these performance levels for your students. Some performance standards, such as working safety, should probably be set at the 100 percent level. Your professional judgment, and the abilities of your individual students, provide the basis for determining the standard which students must meet before proceeding to another task objective.

PROGRAM APPROACH AND TECHNIQUE

During the exploratory phase of the Construction Program, students are encouraged to explore several job families in construction. As they enter your class, they have made a more refined choice and should now be prepared to develop a number of specific skills.

To accomplish the purpose of this program, a two-fold approach has been taken. The material has been organized into two distinct components -- Instructor's Guide and Student Resource Manuals.

The Instructor's Guide is organized into a task-by-task outlining of suggested activities structured around behavorial objectives.

LESSON PLANNING

Organization and planning are essential to the success of any program. The four-step lesson plan recommended procedure is:

Step 1 Preparation of the Lesson. Applying the principle of Readiness, the instructor should prepare students for the lesson. Information sheets, reading assignments in the text and Student Resource Manual and other introductory techniques can help to prepare the student.

Step 2 Presentation. Applying the principle of Effect, the instructor should present and demonstrate a given process or activity supported by media and selected student involvement. Tell and show how to do the task step-by-step, citing critical check points and special safety requirements.

Step 3 Application of student performance. Applying the principle of Practice, the instructor should permit the students to do the assigned task. Special work sheets, drawings and instructions should be provided the student when necessary.

Step 4 Performance test. Applying the principle of Criteria, referenced testing is used to determine student performance at acceptable levels. Those students who do not meet acceptable performance standards are cycled through Steps 2, 3 and 4 again.

(See Appendix, Sample Lesson Plan)

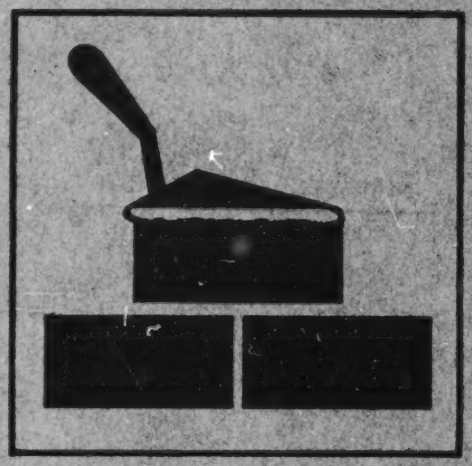
STUDENT RESOURCE MANUAL

The Student Resource Manual is intended to serve as a supplemental text and information manual. It is designed and written for student use and it is structured to compliment the Instructor's Guide. Subjects such as tools and equipment, materials, processes and safety are discussed. A glossary of terms is included in each student manual.

The success or failure of a preparation program can depend on many things. It is hoped that you will encourage student participation in youth organizations which promote scholarship and craftsmanship. VICA organizations have been very successful in motivating and recognizing student accomplishments. If your school does not have a VICA chapter, you can be instrumental in starting one. The rewards to the community, school, and especially the student, can be readily apparent. Other student organizations, such as DECA, may be of interest to students aiming for careers in the wholesaling and retailing of construction products.

Of further value to your program would be the establishment and maintenance of a strong advisory committee. The involvement of members of the community can help to promote your program. A committee of this kind can form a solid bridge between school and community. If your school does not have a construction advisory committee, it is time to start one. The exchange of ideas can benefit both the school and community.

CONCRETE WORKING



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MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to stake out and erect batter boards for a building.

SOURCES OF INFORMATION

None

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Level, plumb and square
- Related geometry

Communication Skills

- Student Resource Manual
- Vocabulary Development
- Blueprint reading and symbols.

MASONRY

CONTENT TITLE: Batter Boards

SUB OBJECTIVE I: The student will demonstrate ability to erect batter boards for a building.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates erecting batter boards.

A. Drive outside stakes far enough outside building lines so they will not be disturbed during excavation. Position to form lines parallel to proposed building lines.
B. Nail boards to stakes at a specified elevation to form an "L", the arms of which are parallel to building lines.
C. Position cords over and along proposed building lines.
D. Locate cords directly over lines through corner hubs by holding plumb bobs over hubs and touching cords to bob line.
E. Nail lines to boards.
F. Mark batter boards as to elevation information, line information, etc. on each batter board.

II. Students erect batter boards.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to store, position and tie steel for beams, slabs and columns.

SOURCES OF INFORMATION

Durbahn, Walter E., Fundamentals of Carpentry, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Lux, Donald G. and Willis E. Ray, The World of Construction (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Mix, Floyd, Practical Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1963.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Material and tool sizing
- Angles and degrees

Science

- Properties of concrete
- Reinforcement - wire and rods

Communication Skills

- Working drawings
- Related safety
  - Working concrete
  - Tying steel
  - Protective clothing

MASONRY

CONTENT TITLE: Steel

SUB OBJECTIVE 2: The student will demonstrate ability to clean and store reinforcing steel.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates and discusses cleaning and storing steel bars.

   A. Mention that bars should be kept off ground for outside storage.
   B. Mention that some protection is desirable to avoid excessive rust.
   C. Mention that a thin film of rust or mill scale is not considered to be seriously objectionable in fact it may increase the strength of the steel-concrete bond.
   D. Describe materials that would be objectionable if allowed to remain on reinforcing steel (oil, paint, grease, dried mud and weak dried mortar).
   E. Demonstrate removing loose rust and scale by rubbing with dry burlap.
   F. Demonstrate cleaning procedures.

II. Students clean and store steel re-bar.

MASONRY

CONTENT TITLE: Footing

SUB OBJECTIVE 3: The student will demonstrate ability to build and place concrete footings for basements.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building and placing footings for basements.

A. Stake out site or square site for foundation footings.
B. Excavate soil to form a mold for concrete wall footing (example 1' 4" x 10").
C. Demonstrate using all earth forms, with no wood.
D. Demonstrate tying steel for footings outside of earth forms.
E. Tie three #4 continuous main longitudinal reinforcement bars and anchor them to stirrups.
F. Pass stirrups under bottom of longitudinal steel to prevent lateral slippage.
G. Use stirrups to tie all splices together with a two foot lap, or splice, to resist all diagonal tension.
H. Place steel into earth form. Support steel on bolsters to hold off the ground during placing.
I. Moisten earth thoroughly before placing concrete on earth forms.
J. Demonstrate depositing concrete into even horizontal layers; do not puddle or vibrate into place.
K. Demonstrate working concrete around reinforcing bars.
L. Demonstrate screeding.
M. Demonstrate placing a 2 x 4 in center of footing for a keyway. The keyway is formed by pressing the 2 x 4 into the concrete (about 2") before it has set and removing it after the concrete has set.
N. Leave surface of concrete rough for wall sections.

II. Students build and place footings for basements.

MASONRY

CONTENT TITLE: Steel

SUB OBJECTIVE 4: The student will demonstrate ability to place and tie steel for a basement wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates placing and tying steel for a basement wall.

   A. Mention the fact that steel should be placed as the wall is being built or erected, unless wire fabric is used.
   B. Demonstrate keeping steel the proper distance from forms. Locate steel accurately and tie firmly into place.
   C. Use supports, spacer bars, wire, or other devices to prevent displacement of steel during construction.
   D. Demonstrate placing concrete bats or clean, sound stones to support the steel at a proper distance above the footing.
   E. Demonstrate tying steel using 18 gauge wire or larger.
   F. Demonstrate using welded wire fabric for reinforcement walls.

II. Students place and tie steel for a basement wall.

MASONRY

CONTENT TITLE: Steel

SUB OBJECTIVE 5: The student will demonstrate ability to tie and position steel slab.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates placing and tying steel for a slab.

A. Select steel and lay out. If beam span is less than 14', use #3 or 3/8" bars, 16" o.c., both directions. If beam spacing exceeds 14', use #4 or 1/2" (4/8"), 12" o.c. both directions.

B. Demonstrate bending steel members or placing precast bent bars or truss bars for drop in elevation of garage floor.

C. Tie cross joints and corners.

D. Tie slab steel to beam steel, and lift on bolsters, high chairs, bats, etc. Tie porch to slab.

E. Place mesh for patio reinforcing.

F. Demonstrate placing extra steel and concrete under fireplace footing to support additional weight there.

G. On L shaped foundation corners, place three or four diagonal steel members for additional support.

H. Add additional #3 bar steel under air conditioner pad.

II. Students place and tie steel for a slab.

MASONRY

CONTENT TITLE: Steel

SUB OBJECTIVE 6: The student will demonstrate ability to tie and position beam steel.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates placing and tying steel for beams.

A. Tie beam steel outside of the form using a jig to fold the steel. Tie stirrups to steel.
B. Position main reinforcing rods, or four-beam bars, in jig. Anchor stirrups to longitudinal reinforcement steel.
C. Use stirrups to tie all bend bars and splices together. Lap should be 2' and stirrups should be positioned on 2' or 4' centers.
D. Tie stirrups on bottom of longitudinal steel and perpendicular to it. This prevents lateral slippage.
E. Tie stirrups with one turn of wire each way to form an "x" around the steel. Beam steel should be fastened with 18 gauge or larger wire.
F. Place stirrups so that every potential diagonal tension crack is crossed by at least one stirrup.
G. Demonstrate laying beam steel into ditches.
H. Tie all corners with a 2', 90° angle steel, one per rod, top and bottom. (Minimum is usually four per corner).
I. Tie all intersections of beams with a 2', 90° angle steel, one per rod, top and bottom. (Minimum is usually four per intersection.)
J. Support beam steel on bolsters or high chairs to hold bars in place, off the ground during placing operations.

II. Students tie and locate beam steel.

MASONRY

CONTENT TITLE: Spiral Columns

SUB OBJECTIVE 7: The student will demonstrate ability to build and place a spiral column.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building and placing a spiral column.

A. Clean pads or footings placed with wall footing.
B. Build spiral steel column, with longitudinal steel encircled by a continuous spiral reinforcement.
C. Demonstrate tying spiral and vertical steel together.
D. Demonstrate building forms around steel or using precast cylinder forms. If surface of precast form is not finished, oil before erecting.
E. Place concrete into forms, using layers from 6 to 24" in depth depending on size of form. Vibrate externally.
F. Remove forms when concrete has set. Rub down with a carborundum stone to smooth off column. Keep concrete damp while rubbing and take care not to pull aggregate out.
G. Rub column with cement and water to fill all low spots.

II. Students build and place a spiral column.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to rough in plumbing prior to placing a concrete slab.

SOURCES OF INFORMATION

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Mix, Floyd, Practical Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1963.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Vapor barriers
- Expansion and contraction of concrete
- Other problems of concrete

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Vocabulary development

MASONRY

CONTENT TITLE: Plumbing

SUB OBJECTIVE 8: The student will demonstrate ability to rough in plumbing for a slab.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates roughing in plumbing for a basement.

A. Set cast iron (waste water) or plastic pipe.
B. Lay waste water lines to grade and check grade.
C. Lay plastic pipe for air conditioning if required.
D. Set lead seat (or setting ring) if water closet is to be installed in basement.
E. Set drain for tub or shower if they are to be installed on slab floor.
F. Set vent pipe stub for water closet and lavatory.
G. Set drain line for sink if required.
H. Set drain for washer if required.
I. Place all copper pipe. Copper pipe under concrete must be free of joints.
J. Emphasize that all sewer, water, gas and oil supply lines must be installed before the slab is poured.
K. Remove top soil and organic matter and place a layer of fill dirt or crushed stone. This should not exceed 12" and must be tamped or settled.
L. Lay at least a 4" layer of coarse gravel or crushed rock above pipe and ground line and tamp well.
M. Place a permanent, waterproof, nonabsorptive type of rigid insulation around the perimeter of the slab for cold climates; in mild climates an expansion joint will be sufficient.
N. Lay a waterproof polyethylene or tarpaper with hot mop covering from footing to footing and around columns. Tape all cuts with duck tape.
O. Set slope for sump pump if required and tamp earth.
P. Install 1/2" premolded expansion joint to prevent cracking due to shrinkage or temperature changes.
Q. Place and cut 6 x 6 #10 wire mesh for reinforcing in slab.
R. If slab bolsters are unavailable, mesh may be lifted with blocks, bricks or mortar bats.

II. Students rough in plumbing for a slab.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to mix, estimate, place and finish a concrete slab.

SOURCES OF INFORMATION

Lux, Donald, G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Ratios and proportions
- Estimation
- Percentages

Science

- Elements of concrete
- Additive
- Protective techniques

Communication Skills

- Student Resource Manual
- Technical literature

MASONRY

CONTENT TITLE: Mixing & Estimating

SUB OBJECTIVE 9: The student will demonstrate ability to mix and estimate concrete.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses and demonstrates mixing concrete.

A. Discuss relationships between cement, sand and aggregate and cure time, strength, workability, etc. charactertistics.
B. Demonstrate basic mixing procedures. To do this, measure dry ingredients and mix (typical measurements for this exercise might be 225 lbs. sand, 390 lbs. gravel, 94 lbs. cement).
C. Add water and mix (6 gallons for above outlined measurements). Yield from this mix should be 4.66 cubic feet "raw" or "green" concrete.

II. Instructor discusses and demonstrates estimating concrete requirements for a small job.

A. Estimate volume of slab. Use multiplying tables, concrete calculators or do the work by hand.
B. Estimate volume of exterior and interior beams as before.
C. Estimate volume of patios, sidewalks and driveway(s), etc.
D. Point out the fact that concrete is purchased by the cubic yard. It will therefore be necessary to divide total cubic footage obtained above by 27 to obtain the number of "yards" required.
E. To the last figure, add 5 percent as a handling loss factor for small jobs, and 10 percent for jobs over 200 cubic yards.
F. Add compaction figure.

III. Students mix and estimate concrete.

MASONRY

CONTENT TITLE: Slabs

SUB OBJECTIVE 10: The student will demonstrate ability to place and finish a concrete floor.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates placing and finishing concrete for a basement.

A. Place concrete in corners of slab first, placing each batch against batch previously dumped; work flat.
B. Use discharge chute from truck to deposit concrete in even, horizontal layers.
C. Carefully work concrete around all reinforcing steel to ensure proper embedding of steel in concrete.
D. Tamp or vibrate to lower larger size aggregate. This will make screeding easier.
E. Strike off excess concrete in order to bring the surface to correct elevation. Work with a straight board and in a back and forth sawing motion.
F. Demonstrate floating with a long-handle four foot wooden float to level the work; this process should take place shortly after screeding while concrete is still workable.
G. Emphasize that concrete must not be overworked. Overwork will bring an excess of water and mortar to the surface. This fine material will form a thin, weak layer that will scale or wear off.
H. Work large surface with a power trowel, then finish around fixtures with steel trowels. Demonstrate steel troweling when a water sheen disappears from the concrete surface and dry cement or water should not be used to aid in finishing surface.
I. Demonstrate troweling a surface that has a finely textured, but not slippery finish; this finish may be obtained by troweling lightly over the surface with a circular motion immediately after the first regular troweling.

Continued ...

CONTENT TITLE: Slabs (Continued)

SUB OBJECTIVE 10: The student will demonstrate ability to place and finish a concrete floor.

SUGGESTED ACTIVITIES: (Students and Teachers)

J. Point out that troweling should leave the surface smooth, even and free from marks and ripples; spreading dry cement on a wet surface to take up excess water is not a good practice, as the resulting surface lacks durability.

K. Demonstrate using curing compounds; these compounds restrict evaporation of water and should be applied to the finished surface as soon as free water has disappeared.

L. Keep concrete damp during curing process by covering with burlap or sand and/or by moistening for 3 to 7 days.

II. Students place and finish a concrete floor.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to build, check and inspect forms, prepare earthwork, vaporproof and finish a concrete slab.

SOURCES OF INFORMATION

Durbahn, W. E., Fundamentals of Carpentry, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Mix, Floyd, Practical Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1963.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Pressures of concrete

Communication Skills

- Vocabulary development
- Student Resource Manual

MASONRY

CONTENT TITLE: Slabs

SUB OBJECTIVE 11: The student will demonstrate ability to build, check and inspect forms for a house slab.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building, check and inspecting forms for a house slab.

A. Drive stops for studs or braces into ground before excavation of beam. Slab will then lie along edge of earth excavation of exterior beams.
B. Nail "two by" planks or 3/4" plywood sheathing on to studs to serve as sheathing for wall forms.
C. Set string elevation and level. Use surveying instruments to set and check grade line of batter boards.
D. Check elevations at all corners with surveying instrument. Drive braces down to required elevation of finished slabs.
E. Set form around porch, leaving retainer for main slab. In this way, mortar can be forced under main slab retainer to join porch mortar.
F. Demonstrate nailing bracing.
G. Demonstrate constructing stake bracing so that it will withstand impacts from dumping concrete, starting and stopping concrete vibrator, etc.
H. Build forms up around slab to a height of 8" above highest ground line with crushed stone or fill sand 5" below finished slab elevation.
I. Check exterior beam depth and excavate to a depth of 30" (or to bedrock) below top of form.
J. Demonstrate setting 2 x 6's for brick ledges. (The 2 x 6 is layed edgeways with its top surface level with floor elevation.)

Continued ...

CONTENT TITLE: Slabs (Continued)

SUB OBJECTIVE 11: The student will demonstrate ability to build, check and inspect forms for a house slab.

SUGGESTED ACTIVITIES: (Students and Teachers)

K. Demonstrate setting 2 x 4's for 3-1/2" or 1-1/2" garage floor drops. Indicate required garage slab slope in forming using duplex nails.

L. Set door lip or drop in garage floor for garage door. (Check door manufacturer's specifications for required lip.)

M. Set approach ramp to garage door.

N. Demonstrate setting "two by" forming for all recessed areas in slab floor to depth of recess.

II. Students build, check and inspect forms for a house slab.

MASONRY

CONTENT TITLE: Slabs

SUB OBJECTIVE 12: The student will demonstrate ability to dig ground beams and fill voids with crushed stone.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates digging trenches and filling voids with crushed stone for slab beams.

A. Remove top soil and organic matter from slab area for use in filling yard.
B. Stake out site and square for foundation beams. (Diagonals will be equal if building is square.)
C. Excavate soil to form a mold for a 10 x 30 concrete perimeter beam.
D. Excavate soil for a 10 x 24 beam to run lengthwise above center of slab.
E. Demonstrate excavating the soil to form cross beams with not more than a 14' separation between beams (generally considered a safe maximum).
F. Build soil up around beams with dirt filled sacks. Slab should stand a minimum of 3" above highest ground line, plus 5" for concrete.
G. Set dirt sacks level with the horizontal ground line to form a uniform slab thickness of five inches.
H. Fill slab area with crushed stone, coarse gravel, or sand to level of dirt sacks; this should be done after plumbing is roughed-in with all fill being tamped before crushed stone is added.
I. Set elevation for garage fill as 3-1/2" below that of slab floor elevation.

II. Students dig trenches and fill voids.

MASONRY

CONTENT TITLE: Vapor Proofing

SUB OBJECTIVE I3: The student will demonstrate ability to lay a permanent polyethylene membrane.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying a permanent polyethylene membrane.

A. Cover all of slab and beam area with membrane material.
B. Demonstrate cutting or folding waterproofing, where beams cross or meet. Tape cuts or folds with ducking tape.
C. Cut out area for beams, leaving a minimum of a one foot lap on each side.
D. Demonstrate taping polyethylene cuts around plumbing.
E. Demonstrate laying waterproofing from form to form, pushing visquene into beams to form contour without cutting materials.

II. The student will lay a permanent polyethylene membrane material.

MASONRY

CONTENT TITLE: Slabs

SUB OBJECTIVE 14: The student will demonstrate ability to finish "voids in" a slab.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates filling and finishing voids in slab foundation.

A. Demonstrate using care to pry form materials from concrete surface.

B. Demonstrate making the first rub with a course carborundum stone as soon as the surface has hardened so aggregate is not pulled out.

C. Demonstrate applying a mortar layer of rich cement and sand to surface of void, although this should be kept to a minimum as it can scale off and mar the appearance of the surface.

D. Demonstrate removing excess mortar from surface after it has dried by rubbing with a dry burlap sack or rubber float to remove loose materials.

E. Demonstrate if concrete has been cured and finished properly, there will be very few pores through which water can enter and freeze.

F. Demonstrate if rubbing concrete surface with stone or burlap each section should be completed without stopping.

II. Students finish a slab.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to treat forms with, pour concrete into and strip forms from concrete walls.

SOURCES OF INFORMATION

Durbahn, Walter E., Fundamentals of Carpentry, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1969.

Lux, Donald G. and Willis E. Ray, The World of Construction, (McKnight and McKnight: U. S. Route 66 at Towanda Avenue, Bloomington, Illinois 61701), 1970.

Mix, Floyd, Practical Carpentry , (Goodheart-Wilcox Co., Inc.: 123 West Taft Drive, South Holland, Illinois 60473), 1963.

Wagner, Willis H., Modern Carpentry, (Goodheart-Wilcox Co., Inc: 123 West Taft Drive, South Holland, Illinois 60473), 1969.

ACADEMIC RELATED THEORY AND INFORMATIONN

Math

- Review math requirements for job entry or higher education

Science

- Review of science requirements for job entry or higher education

Communication Skills

- Vocabulary development
- Student Resource Manual
- Review communication skills required for job entry or higher education
- Review of career and job opportunities
  - Job
  - Apprenticeship
  - Higher education

MASONRY

CONTENT TITLE: Walls

SUB OBJECTIVE 15: The student will demonstrate ability to treat forms with form release compound.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates treating forms with various form-release compounds.

   A. If forms are to be used repeatedly, paint them for protection.
   B. Demonstrate treating form with form oil or other coating material.
   C. Demonstrate treating with a penetrating coating to prevent form from absorbing water and causing sand streaking.
   D. Discuss merits of treating with shellac when a low grain rise is desired.
   E. Emphasize that columns and wall forms should be oiled before being erected; other forms may be treated when convenient but must be treated before reinforcing steel is positioned.

II. Students treat forms with form-release compounds.

MASONRY

CONTENT TITLE: Walls

SUB OBJECTIVE 16: The student will demonstrate ability to place concrete in a wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates placing concrete in walls.

A. Position chute for placing concrete and wet chute thoroughly. Position so that concrete need not fall further than three to five feet. Mention that greater falls put excessive strain on forms.
B. Start placing concrete, working from end to middle of forms.
C. Continue placing concrete, pouring in layers of from 6" to 24" depending on width of forms.
D. Work concrete around reinforcement bars, bedded fixtures, tie wires, etc. Work carefully into corners and along sides of forms. Do not pour faster than this may be done.
E. Demonstrate vibrating concrete with internal and external vibrators. Internal vibrators should be inserted several inches into previous layer to ensure a good bond between layers.
F. Demonstrate applying external vibrator equipment to forms. With both types, do not over-vibrate. Small air gaps increase strength of concrete.
G. Overfill form and screed off immediately prior to setting.
H. Place hooked type anchor bolts carefully to avoid disaligning them.
I. Waterproof outside walls.
J. Apply mortar layers if required.

II. Students place concrete in a wall.

MASONRY

CONTENT TITLE: Salvaging

SUB OBJECTIVE I7: The student will demonstrate ability to remove, clean and salvage form materials.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates removing, cleaning, salvaging and storing form materials.

A. Remove forms in reverse order.
B. Use care in prying form material from concrete surface so as to avoid damaging concrete surface.
C. Use caution when removing nails from form wood and when removing materials from site.
D. Salvage as much of the form materials as safely possible, discarding all split and broken braces and stakes.
E. Remove form material from the patio, steps or porch, sidewalk and driveway.
F. Scrape and brush concrete from form lumber in clean-up operation.
G. Remove form ties a few days after forms have been removed. Remove ties by twisting and pulling on the tie so that it breaks off beneath concrete surface.
H. Grout tie holes.
I. Treat forms with a penetrating oil coating to preserve them for future use.
J. Store form materials outside on wooden blocks or boards to keep them off the ground.
K. Stack materials properly and safely.

II. Students strip, clean and store forms.

BRICK AND BLOCK LAYING

35

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to prepare mortar for and construct a straight section of brick wall.

SOURCES OF INFORMATION

Bricklayer's Vocational Training Textbook, (Brick Institute of America: 1750 Meadow Road, McLean, Virginia 22101), 1973.

Bricklaying I, (DelMar Publishers: P.O. Box 5087, Albany, New York), 1952.

Graham, Frank D., Audels Masons and Builders Guide #1, (Theodore Audel & Co., Division of Howard W. Sams & Co.: 4300 West 62nd Street, Indianapolis, Indiana), 1960.

Mulligan, J., Handbook of Brickmasonry Construction, (McGraw-Hill Book Company: 1221 Avenue of the Americas, New York, New York 10020), 1942.

Ray, J. E., The Art of Bricklaying, (Charles A. Bennett Co.: 809 West Detwieller Drive, Peoria, Illinois), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Mixing ratios
- Level and plumb
- Measuring
  - Whole numbers
  - Decimals
  - Fractions

Science

- Cement bonding
- Clay products

Communication Skills

- Student Resource Manual
- Technical literature
- Related safety
  - Handling cement and other materials
- Working drawings

MASONRY

CONTENT TITLE: Mixing Mortar

SUB OBJECTIVE I: The student will demonstrate ability to prepare mortar for brickwork and to determine if the mortar mixed is fat, lean, or of the correct consistency.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the proper mixing procedure for mortar.

A. Sift ingredients if necessary.
B. Measure dry ingredients.
C. Mix dry ingredients.
D. Add water until mixture is lean.
E. Remove some of the lean mixture and demonstrate its characteristics.
F. Allow students to experiment with this mixture.
G. Add water to lean mixture until correct consistency is reached. Remove some of this mixture and allow students to experiment with the correct mixture.
H. Add cement to a sample of correct mixture and demonstrate its sticky characteristics. Allow students to experiment with this mixture.

II. Students practice mixing mortar.

MASONRY

CONTENT TITLE: Spreading Mortar

SUB OBJECTIVE 2: The student will demonstrate ability to spread mortar.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates spreading mortar for brickwork.

A. Lightly grasping the trowel, pick up a well rounded trowelful of mortar.
B. Start the stringing with a smooth motion to the left.
C. When the mortar begins to slide off, move the trowel along the course of brick. Turn the trowel so that the mortar falls off and onto the course smoothly and evenly.
D. Continue to spread mortar along course. For cavity wall construction, demonstrate beveling bed away from cavity to avoid allowing mortar to drop into cavity.
E. Furrow mortar with inverted point of trowel. Cut off any excess.

II. Students spread mortar for a course of brickwork.

MASONRY

CONTENT TITLE: Buttering Brick

SUB OBJECTIVE 3: The student will demonstrate ability to butter brick.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates buttering brick.

A. Start with at least one course already laid and bedded for next course.

B. Demonstrate holding brick. (For stretcher courses and for laying soldiers, shiners and rowlocks, the brick is grasped in the face and back. For headers and sailors, the brick must be grasped on the top and bottom.)

C. Cut excess mortar from bed and apply with a wiping motion to end of previously laid brick.

D. Place next brick a little in advance of its final position and press into place by pushing down and towards final position.

II. Students practice buttering brick.

MASONRY

CONTENT TITLE: Laying Brick to a Line

SUB OBJECTIVE 4: The student will demonstrate ability to lay brick to a line.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying bricks to a line.

A. Erect a line above a previously laid course of brick level and even with the top of next course.

B. Spread mortar and position first brick. Press down to make top of brick level with line.

C. Butter last brick and position next brick. Press down as before. Demonstrate proper way of holding brick so that mason's line will not be disturbed. Demonstrate tapping brick into position with handle (or blade) of trowel.

D. Continue laying brick, positioning them level to the line, the thickness of the line away from the line until students understand the correct positioning techniques.

E. Discuss importance of maintaining proper bond.

II. Students lay brick to a line.

MASONRY

CONTENT TITLE: Using the Level

SUB OBJECTIVE 5: The student will demonstrate ability to use a mason's level to level and plumb brickwork.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates use of the level.

A. Set up a course, with first element of course correct to height.
B. Lay a few additional brick. Demonstrate positioning level along top of brick from point of height. Check both horizontal axes.
C. Demonstrate plumbing the work. (If work is well done, plumb may be taken by aligning level along one edge of a wythe. If not, a plumb bob may also be used, but this is not often done.)
D. Demonstrate straightedging the work; i.e., position level along face of one course, and adjust individual bricks to keep faces lined up in both directions.
E. Introduce the four rules for laying brick:
   1. Keep the work on height.
   2. Level the work from the point of height.
   3. Plumb the work.
   4. Straightedge the work.

II. Students practice using a mason's level while practicing the four rules of bricklaying.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to lay out and construct inside and outside corners and four, six and eight brick piers.

SOURCES OF INFORMATION

Department of the Army, Concrete and Masonry, TM 5-742. (Order from Government Printing Office, Document No. D101.11:5-742/2).

Bricklaying I, (DelMar Publishers: P. O. Box 5087, Albany, New York), 1952.

Ray, J. E., The Art of Bricklaying, (Charles A. Bennett Co.: 809 West Detwieller Drive, Peoria, Illinois), 1972.

Vocational and Apprentice Training Trade Projects #2 and #5, (Brick Institute of America: 1750 Meadow Road, McLean, Virginia 22101), 1973.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Squaring
- Linear measurements

Communication Skills

- Technical literature
- Student Resource Manual
- Working drawings
  - Drawing and interpretation

MASONRY

CONTENT TITLE: Building a 4" Corner

SUB OBJECTIVE 6: The student will demonstrate ability to build a 4" corner.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying a 4" corner (veneer wall).

A. Lay out a straight line on the floor with a chalkline.
B. Strike the corner using a steel square, or lay out a square and use the diagonals method to true up the corner. Strike another chalkline, and erect mason's lines.
C. Lay out the first courses. Ensure that they are long enough to accommodate the desired height of the corner, allowing the wall to drop, half a brick at a time, down to the first course.
D. Spread mortar and lay second course, ensuring that bricks interlock at the corner.
E. Remind students of necessity of observing the mason's four rules of bricklaying.
F. Continue building up the corner until desired height is obtained, following the four rules of the mason.

II. Students lay up a 4" corner (veneer wall).

MASONRY

CONTENT TITLE: Building an Inside-Outside 4" Corner

SUB OBJECTIVE 7: The student will demonstrate ability to build an inside-outside corner with a jamb and to properly rake and clean mortar joints.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building inside-outside corners with a jamb.

A. Demonstrate cutting brick with mason's hammer; cut by scoring brick all the way around with the hammer head, and then striking the brick a sharp blow to one side of the cutting line. The rough face thus produced may then be trimmed with the trimming edge of the hammer.

B. Demonstrate cutting brick for precision fit with a brick chisel or bolster; cut by first scoring a line all the way around the brick. Position the flat face of the bolster towards the part of the brick to be saved and along the score lines- a sharp blow with the hammer will produce a clean break along the cleavage lines.

C. Lay out guidelines and first courses. Try to arrange so that a full brick will rest direct aginst the jamb on the first course.

D. Lay out succeeding courses, ensuring that bricks interlock at the corners. Alternate courses will require that a brick be cut to fit against the jamb.

E. When mortar is finger hard, demonstrate raking the joints. Discuss different patterns of raking and their typical applications. Emphasize that raking should compress the mortar and not merely scrape the mortar to the desired shape.

II. Students build an inside-outside corner with a jamb.

CONTENT TITLE: Building a Four Brick Pier

SUB OBJECTIVE 8: The student will demonstrate ability to build a four brick pier.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building a four brick pier.

A. Lay out first course, in a square, back to head, back to head and so on.
B. Lay up succeeding courses, following the four rules of bricklaying, and ensuring that corners overlap.
C. When mortar is finger hard, tool, brush and cleanup.

II. Students construct a four brick pier.

CONTENT TITLE: Building a Six Brick Pier

SUB OBJECTIVE 9: The student will demonstrate ability to lay out and fabricate a six brick pier.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and building up a six brick pier.

A. Lay out first course. The course is composed of two "L's", the short leg of which is arranged so that the back or face of the brick is contiguous to the end of the long leg. Other two sides of the pier are arranged similarly; however, the "L's" are inverted. The six brick pier is rectangular.
B. Spread mortar, butter brick and lay up succeeding courses, ensuring that each course interlocks with the preceding one.
C. Emphasize that the student should follow the four rules of bricklaying in laying up the pier.

II. Students lay up a six brick pier.

MASONRY

CONTENT TITLE: Building an Eight Brick Pier

SUB OBJECTIVE 10: The student will demonstrate ability to build an eight brick pier.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying up an eight brick pier.

A. Lay out first course. (First course is laid out similarly to that of a six brick pier; however, each side shows two and one-half brick faces. The eight brick pier is square.)

B. Spread mortar, butter brick and lay up succeeding courses, ensuring that each course interlocks with the preceding one.

C. Emphasize that the student should follow the four rules of bricklaying in laying up the pier.

II. Students construct an eight brick pier.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to lay out and lay up 8" brick walls in American, English, Flemish and Dutch bonds.

SOURCES OF INFORMATION

Bricklayer's Vocational Training Textbook, (Brick Institute of America: 1750 Meadow Road, McLean, Virginia 22101), 1973.

Dalzell, J. Ralph, et.al., eds., Masonry Simplified, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1962.

Mulligan, J., Handbook of Brickmasonry Construction, (McGraw Hill Book Co. 1221 Avenue of the Americas, New York, New York 10020), 1942.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Vocabulary development
- Student Resource Manual
- Blueprint interpretation

MASONRY

CONTENT TITLE: Learning Brick Bonds

SUB OBJECTIVE II: The student will demonstrate ability to lay up American, English, Flemish and Dutch bonded walls.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses purposes and designs of wall bonds.

A. Discuss structural advantages of bonding patterns.

B. Identify, define, or demonstrate layout patterns for American (three stretcher courses, alternated with one header course, sometimes called three stretcher bond, English (stretcher/header/stretcher/header), Flemish (alternating stretchers and headers in each course, with succeeding courses overlapped) and Dutch.

C. Demonstrate different techniques of buttering bricks for special bond patterns.

II. Students practice laying up different bond patterns.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to work openings into brick walls and to span openings in brick walls using lintels and Roman arches.

SOURCES OF INFORMATION

Bricklaying I, (DelMar Publishers: P.O. Box 5087, Albany, New York), 1952.

Brick and Tile Engineering, (Brick Institute of America: 1750 Meadow Road, McLean, Virginia 22101), 1962.

Bricklayer's Vocational Training Textbook, (Brick Institute of America: 1750 Meadow Road, McLean, Virginia 22101), 1973.

Dalzell, J. Ralph, et.al., eds., Masonry Simplified, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1962.

Graham, Frank D., Audels Masons and Builders Guide #1, (Theodore Audel & Co., Division of Howard W. Sams & Co.: 4300 West 62nd Street, Indianapolis, Indiana), 1960.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Using a square rule
- Material sizing
- Material estimating

MASONRY

CONTENT TITLE: Laying a Brick Sill

SUB OBJECTIVE 12: The student will demonstrate ability to lay a brick window sill.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying a brick window sill with Rowlocks.

A. Calculate layout of sill using a spacing rule.
B. Bed mortar over top course at approximately the correct angle for the final sill.
C. Start laying brick from each end, working from right to left and from left to right.
D. Butter top and bottom of bricks on either side of closer space; likewise butter closer brick. Ease closer brick into closer space, being careful to maintain an even and solid bond.
E. Ensure that bricks are level and plumb to each other (they will, of course, not be level with respect to ground or remaining portions of structure).
F. When mortar is finger hard, tool or rake joints, brush and clean brickwork.

II. Students lay a brick window sill with rowlocks.

MASONRY

CONTENT TITLE: Working Openings (Doors and Windows) into a Brick Veneer Wall

SUB OBJECTIVE 13: The student will demonstrate ability to work in door, window and other openings into walls of brick.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses working openings into brick walls.

A. Discuss openings in well planned walls (walls where designer has considered brickwork when designing openings).

B. Discuss working in walls where design has not been well considered from the mason's point of view.

II. Instructor demonstrates working an opening into a wall where design required adjusting brickwork.

A. Demonstrate stretching and compressing joints to gain or lose length.

B. Demonstrate measuring and cutting brick bats to 1/2, 1/4 and long and short 3/4 sizes.

C. Lay out and start a wall with a non-modular opening to allow students to practice cutting, stretching and compressing brickwork.

III. Students work an opening into a brick wall.

MASONRY

CONTENT TITLE: Crossing an Opening with a Steel Lintel

SUB OBJECTIVE 14: The student will demonstrate ability to properly cross an opening with a steel lintel.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses difficulties of laying brick over an opening using steel lintels.

   A. Identify types of steel lintels.
   B. Discuss criteria for placement of lintels (i.e., 1/2" underhang, at least 4" into solid portion of wall, or at least 1/2 masonry unit).
   C. Discuss proper layout of bond to ensure proper carryover of the lintel.

II. Instructor demonstrates placing lintels and laying brick over them.

   A. Measure, locate and place lintel over top course, dry.
   B. Work brick up to lintel.
   C. Firmly bed lintel at both sides.
   D. Carry head joints across lintel dry. (Bed stretchers on back and unexposed portions of bottom of brick only.)
   E. Continue upper portion of wall as usual.

III. Students practice placing lintels and laying brick over them.

MASONRY

CONTENT TITLE: Laying a Soldier Course on a Brick Veneer Wall

SUB OBJECTIVE 15: The student will demonstrate ability to lay a soldier course on a brick veneer wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying a soldier course on a brick veneer wall.

   A. Demonstrate buttering brick for laying a soldier course (top and bottom of brick are buttered; the head is layed in a mortar bed).
   B. Demonstrate laying a soldier course from right to left and from left to right.
   C. Demonstrate laying soldier courses one flush and one 1" out.
   D. Demonstrate cutting a Queen Closure (1/2 brick cut lengthwise).
   E. Demonstrate placing Queen Closures to keep appearance of soldier course even at the corners of veneer walls.

II. Students lay soldier courses in 4" brick veneer walls.

MASONRY

CONTENT TITLE: Building a Roman or Semi-Circular Arch

SUB OBJECTIVE 16: The student will demonstrate ability to build a Roman, or semi-circular arch.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses general considerations in arch design and construction.

A. Discuss construction and erection of scaffolding, or temporary support (standard practice allows 3/4" plywood, cut to the shape of the arch, and attached to 2 x 4's for arches up to 6' in span. Scaffolding is usually rested on wedges which may be knocked out when the mortar has set.)

B. Discuss bonding techniques (standard practice allows for mortar joints no less than 1/4" at any point. Any pattern may be used, but a regular course of soldiers is preferrable.)

C. Discuss laying out the arch. (Pattern may be positioned on the ground, and bricks positioned around it. With experimentation, the proper number will be arrived at, with the proper joint widths. A spacing rule may also be used here to advantage. Note that an odd number of bricks should always be used, to allow only one brick to occupy the key position.)

II. Instructor demonstrates building a Roman arch.

A. Lay out pattern of arch on two pieces of plywood (3/4" or larger) and cut out.

B. Attach plywood to 2 x 4's.

C. Position scaffolding under site for arch and wedge into place. Stabilize if necessary.

D. Center bricks by marking form with a spacing ruler. Indicate position of key brick.

Continued ...

CONTENT TITLE: Building a Roman or Semi-Circular Arch (Continued)

SUB OBJECTIVE 16: The student will demonstrate ability to build a Roman, or semi-circular arch.

SUGGESTED ACTIVITIES: (Students and Teachers)

E. Start the arch from both sides. Carry the arch up, working on both sides simultaneously.
F. Butter both sides of key position, and butter top and bottom of key brick. Position key brick in arch carefully.
G. Avoid raking joints of arch; however, when mortar is finger hard, joints may be carefully tooled.
H. When mortar has cured, template or support scaffolding may be removed.

III. Students construct a Roman arch.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to lay up and lay out brickwork commonly encountered in gardens such as planters, patios, etc.

SOURCES OF INFORMATION

Bricklayer's Vocational Training Textbook, (Brick Institute of America: 1750 Meadow Road, McLean, Virginia 22101), 1973.

Graham, Frank D., Audels Masons and Builders Guide #1, (Theodore Audel & Co., Division of Howard W. Sams & Co.: 4300 West 62nd Street, Indianapolis, Indiana), 1960.

Walks, Walls, and Patio Floors, rev. ed., Sunset Editors, (Lane Magazine and Book Co.: Menlo Park, California 94025).

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Technical literature
- Student Resource Manual
- Vocabulary development

MASONRY

CONTENT TITLE: Building a Planter

SUB OBJECTIVE 17: The student will demonstrate ability to build a planter box, using American or garden wall bond with a course of headers for the top course.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates building a planter in garden wall bond.

A. Lay out first courses. (Students might build up wall to next-to-last course. Since most plants require good drainage, weep holes should be provided in the lowest course of stretchers.)

B. Demonstrate corner construction for final header course. (If it is desired that no interruption of bond pattern occur in this course, corner will have to be closed with one full brick and two 1/2 bats; if this is not necessary, two full bricks will do.)

C. Demonstrate mixing waterproofing plaster and plastering inside of planter. Do not plug in weep holes.

D. Emphasize that even for planters, bricklayers' work should be neat and follow the four bricklayer's rules.

II. Students build a planter box in American bond (8" wall) with a course of headers for the top course.

MASONRY

CONTENT TITLE: Flat Work (Floors, Walks, Patios)

SUB OBJECTIVE 18: The student will demonstrate ability to do flat brickwork such as is used for floors, walks, patios and hearths.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying bricks flat.

A. Prepare laying bed (i.e., level sand, check level of concrete, etc.).
B. Demonstrate laying a running bond (dry).
C. Demonstrate laying a basket weave bond (dry).
D. Demonstrate laying a herringbone pattern bond (dry).
E. Mention that bricks may be laid flat or on edge. (Note that basket weave patterns laid flat typically have two units per square; basket weave patterns laid on edge typically have three units per square.)
F. Discuss bonding. (Bricks may be joined with wet mortar; dry mortar mix may be brushed into the joints and later wet down; and bricks may be set close and tight with sand used to fill the small cracks. In the latter case, proper bedding is essential if the work is to be permanent. If brick is joined with wet mortar, it may be laid directly on flat concrete or sand, or may be bedded in a thin layer of mortar.)

II. Students perform flat brickwork operation.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to do work in refractory brick to construct fireplaces.

SOURCES OF INFORMATION

Bricklaying III, (DelMar Publishers: P.O. Box 5087, Albany, New York), 1953.

Bricklayer's Vocational Training Textbook, (Brick Institute of America: 1750 Meadow Road, McLean, Virginia 22101), 1973.

Brickmasonry Inland Training Manual, (Inland Steel Co.: 30 West Monroe Street, Chicago, Illinois 60603), 1961.

Lytle, R. J. and Jeanne, eds., The Book of Successful Fireplaces: How to Build, Decorate and Use Them, (Structures Publications: 3258 Grand River Avenue, Farmington, Missouri 48204), 1961.

Modern Refractory Practice, (Harbison-Walker Refractories Co.: Gateway 2, Pittsburgh, Pennsylvania 15222), 1961.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Local city codes
- Manufacturer's literature
- Student Resource Manual

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MASONRY

CONTENT TITLE: Refractory Work

SUB OBJECTIVE 19: The student will demonstrate ability to construct fireproof masonry units of brickwork.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates differences in working with firebrick.

A. Demonstrate mixing fire clay.
B. Demonstrate dipping firebrick.
C. Discuss necessity of preparing firebrick work with closefitting joints. Mention that much firebrick must be trimmed and cut to ensure the necessary close fit.
D. Demonstrate methods of setting firebrick with a hammer.

II. Students work with firebrick.

CONTENT TITLE: Building a Fireplace

SUB OBJECTIVE 20: The student will demonstrate ability to construct a fireplace.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses considerations of building a fireplace.

NOTE: As fireplaces vary enormously in design and principle, as well as the materials of which they are constructed, it is very difficult to give any more than generalized aspects of their construction here. What follows, then, is more a list of major phases of fireplace construction than any guideline to their actual construction. The instructor would be wise to check one of the many books concerning themselves with this subject if he is unfamiliar with the details of fireplace construction.

A. Select plans.
B. Lay out bottom and sides of ash pit if one is used.
C. Start bringing up walls, and install ash dump or clean-out facilities.
D. Continue bringing up walls and corbel chamber up to grate. Fabricate templates and scaffolding and construct trimmer arch if used.
E. Pour hearth bed and lay out floor, bottom, sides and back of firebox. Be sure to use firebrick for firebox floor.
F. If no ash pit is used, start bringing up back and sides of firebox.
G. Lay up sidewalls and back of firebox.
H. Incline work of firebox up to smokeshelf. Set demper and flue tile. Allow for adequate smoke chamber between damper and tile.
I. Begin building up outside of brickwork and rough chimney through the roof.

Continued ...

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CONTENT TITLE: Building a Fireplace (Continued)

SUB OBJECTIVE 20: The student will demonstrate ability to construct a fireplace.

SUGGESTED ACTIVITIES: (Students and Teachers)

J. Complete chimney from roofline to cap. Install proper flashing and provide for chimney hoods or chimney pots if required.
K. Begin building face of fireplace. Corbel work out for brick mantel if required.
L. Lay brick for brick hearth if required.
M. Finish front brickwork.

II. Students build a fireplace.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to prepare mortar and construct a straight section of eight, six and four inch block walls.

SOURCES OF INFORMATION

Apprentice Training for Masons, (National Concrete Masonry Association: P. O. Box 9185, Rosslyn Station, Arlington, Virginia 22209).

Grahm, Frank D., Audels Masons and Builders Guide #1, (Theodore Audel & Co., Division of Howard W. Sams & Co.: 4300 West 62nd Street, Indianapolis, Indiana), 1960.

Recommended Practices for Laying Concrete Block, (Portland Cement Association: Old Orchard Road, Skokie, Illinois 60076).

Type of Workmanship Recommended for Concrete Block Walls, (Louisville Cement Co.: 501 South Second, Louisville, Kentucky 40202), 1958.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Material sizing
- Layout measuring

Communication Skills

- Technical literature
- Manufacturer's literature
- Student Resource Manual
- Vocabulary development
- Related safety
  - Handling blocks

MASONRY

CONTENT TITLE: Spreading Mortar for Block

SUB OBJECTIVE 21: The student will demonstrate ability to spread even courses of mortar for building with concrete block.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates spreading mortar for block work.

A. Lightly grasping the trowel, pick up a well rounded trowelful of mortar.

B. Start the stringing with a smooth motion to the left (for right-handed students).

C. When the mortar begins to slide off, move the trowel along the back edge of the block course. Turn the trowel so that mortar falls off and onto the block smoothly and evenly.

D. Continue to spread mortar all along back side of block course.

E. Spread mortar along front side of block course.

II. Students spread mortar for block work.

MASONRY

CONTENT TITLE: Buttering Block

SUB OBJECTIVE 22: The student will demonstrate ability to butter concrete block.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates buttering block.

A. Pick up a trowelful of mortar as done in laying a mortar course.
B. Swinging the trowel to the left, start the mortar on the back edge of the block at the left side.
C. Draw trowel along edge of block, gradually turning trowel to allow mortar to fall off and onto edge of the block.
D. Continue and butter back side of block. When finished, butter front side of block.

II. Students practice buttering block.

MASONRY

CONTENT TITLE: Laying 8" Block to a Line

SUB OBJECTIVE 23: The student will demonstrate ability to lay 8" block to a line.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying 8" block to a line.

A. Set up two corner poles at an adequate distance apart to furnish 8' of work space per student.

B. Lay out and lay up first course of block allowing for more or less mortar according to the slope of the foundation or floor.

C. Check each course for its conformance to the line. Top edge of block should exactly parallel line and remain one thickness of line away from the guide. Demonstrate using the trowel as a hammer to lightly tap block into place (for correcting slight errors).

D. When mortar joints are finger hard, demonstrate raking and tooling the joints. Discuss different patterns of raking and their typical applications. Emphasize that raking should compress mortar and not merely scrape the mortar to the desired shape.

E. Brush and clean up block work.

II. Students practice laying block to a line.

MASONRY

CONTENT TITLE: Using the Level to Build a 6" Block Corner

SUB OBJECTIVE 24: The student will demonstrate ability to construct a 6" block corner for common bond.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and building a 6" block corner in common bond.

A. Lay out a straight line on the floor with a chalkline.
B. Strike the corner using a steel square, or lay out a square and use the diagonals method to true up the corner. Strike another chalkline and erect mason's lines. Depending on the number of students, it may be advantageous to arrange for two or more corners.
C. Lay out the first course dry, and ensure that it is long enough to allow the wall to be stepped back to the top of the corner.
D. Lay out the first courses in a full bed of mortar. Use a plumb rule to ensure that course is straight, plumb and level.
E. Start second course, ensuring that blocks interlock at the corner.
F. Demonstrate building up the corner to the desired height.

II. Students construct a 6" block corner.

MASONRY

CONTENT TITLE: Laying 6" Block to a Line

SUB OBJECTIVE 25: The student will demonstrate ability to lay 6" (partition) block to a line.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying 6" block to a line.

A. Set up two corner poles at an adequate distance apart to furnish 8' of work space per student.
B. Lay out and lay up first course of block allowing for more or less mortar according to the slope of the foundation or floor.
C. Check each course for its conformance to the line.
D. When mortar joints are finger hard, rake the joints. Brush and clean block work.

II. Students practice laying block to a line.

MASONRY

CONTENT TITLE: Laying 4" Block to a Line

SUB OBJECTIVE 26: The student will demonstrate ability to lay 4" block to a line.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying 4" block to a line.

A. Set up corner speed leads.
B. Lay out and bed first course of block allowing for more or less mortar according to the slope of the foundation or floor.
C. Discuss uses of 6" and 4" block in partition walls and special difficulties which may be encountered with these materials.

II. Students lay 4" block to a line.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to build four and eight inch corners in block.

SOURCES OF INFORMATION

Apprentice Training For Masons, (National Concrete Masonry Association: P. O. Box 9185, Rosslyn Station, Arlington, Virginia 22209).

Recommended Practices for Laying Concrete Block, (Portland Cement Association: Old Orchard Road, Skokie, Illinois 60076).

Type of Workmanship Recommended for Concrete Block Walls, (Louisville Cement Co.: 501 South Second, Louisville, Kentucky 40202), 1958.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- General review of math required by industry

Science

- General review of science required by industry

Communication Skills

- Technical literature
- Related safety - scaffolds
- Blueprint review
- Review career opportunities
  - Apprenticeship
  - Additional training and education
  - Getting and holding a job

MASONRY

CONTENT TITLE: Using the Level to Build a 4" Block Corner

SUB OBJECTIVE 27: The student will demonstrate ability to construct a 4" block corner for common bond.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and building a 4" block corner in common bond.

   A. Lay out the work and erect mason's lines.
   B. Bed and lay first courses and check to ensure that course is straight, plumb and level.
   C. Start second course, using corner blocks on the corner and ensuring that blocks interlock at the corner.
   D. Build up to desired height, observing mason's four rules.

II. Students construct a 4" block corner in common bond.

MASONRY

CONTENT TITLE: Using the Level to Build an 8" Block Corner

SUB OBJECTIVE 28: The student will demonstrate ability to construct an 8" block corner for common bond.

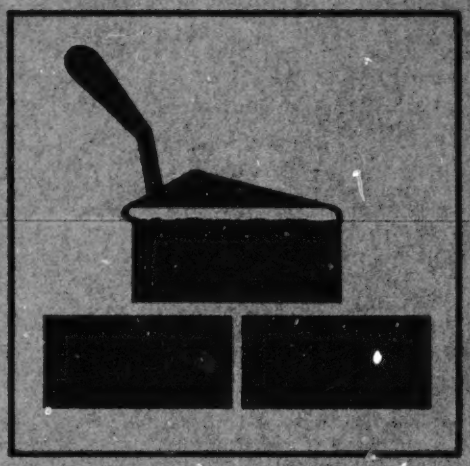
SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out and building an 8" block corner in common bond.

A. Lay out a straight line on the floor with a chalkline.
B. Strike the corner using a steel square, or lay out a square and use the diagonals method to true up the corner. Strike another chalkline and erect mason's lines.
C. Lay out the first course (dry). Ensure that it is long enough to accommodate the desired height of the corner, allowing the wall to drop half a block at a time, down to the first course. Use special corner blocks for corners.
D. Bed first course in a full bed of mortar. Demonstrate use of plumb rule to ensure that course is straight, plumb and level.
E. Lay out first course of other wall similarly.
F. Working from corner, start second course. Ensure that blocks interlock at the corner.
G. Discuss the mason's for rules:
   1. Keep the work on height.
   2. Level the work from the point of height.
   3. Plumb the work.
   4. Straightedge the work (i.e., keep all block's faces lined up in both directions).
H. Continue building up the corner until desired height is obtained, following the four rules of the mason.

II. Students construct an 8" block corner.

PLASTERING



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MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to determine mix and determine the correctness of previously mixed mixtures of various types of plaster for specific applications.

SOURCES OF INFORMATION

Van Den Branded and Knowles, Plastering Skill and Practice, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637). 1953.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Ratios and proportions
- Material and tool sizing

Science

- Types and characteristics of cement plaster

Communication Skills

- Vocabulary development
- Student Resource Manual
- Related safety
  - Ladders and scaffolds
  - Working with metal lath

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MASONRY

CONTENT TITLE: Mortars and Plasters

SUB OBJECTIVE I: The student will demonstrate ability to mix and determine correctness of various types of mixtures for specific applications.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates mixing plasters and mortars. Demonstrations will include preparation of:

A. Gypsum cement plaster.
B. Sanded gypsum plaster
C. Bond plaster.
D. Gypsum gauging plaster.
E. Keene's cement.
F. Trowel finish mixture.
G. Sand float mixture.
H. Various ad-mix plasters.
I. Various vermiculite and perlite mix plasters.
J. Acoustic plaster.
K. Various plasters with retarders.
L. Various plasters with accelerators.
M. Scratch coat mixtures.
N. Brown coat mixtures.

II. Students mix plasters and mortars.

MASONRY

CONTENT TITLE: Lathing

SUB OBJECTIVE 2: The student will demonstrate ability to identify correct installation of metal framing, lathing, beading and molding.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor displays and illustrates various framing, lathing, beading and molding techniques. Techniques shown will include the installation of:

   A. Metal wall systems.
   B. Suspended ceiling furring channels.
   C. Furring channels to wood and metal joists.
   D. Metal lath.
   E. Picture mold.
   F. Plaster stop metal.

II. Students identify correctness of installation of framing, lathing, beading and molding.

MASONRY

OVERALL OBJECTIVE: Given a room ready for plastering, the student will demonstrate ability to determine the squareness of the room and to correct the squareness by the right triangle method and the square method.

SOURCES OF INORMATION

Van Den Branden and Knowles, Plastering Skill and Practice, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1953.

Dalton, Byron W., Practical Plastering and Related Subjects, (Byron W. Dalton: 330 South Marshfield Avenue, Chicago, Illinois 60612), 1949.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Establishing a square (various methods)
- Computing square feet
- Degrees and angles
- Plumb and level

Communication Skills

- Student Resource Manual
- Technical literature
- Blueprint reading

MASONRY

CONTENT TITLE: Preparation

SUB OBJECTIVE 3: The student will demonstrate ability to square a room using the right triangle method (3-4-5 method).

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates squaring a room using the right triangle method.

A. Select straightest wall in room.
B. Measure four feet from one corner along straight wall and mark this distance with a sharp pencil.
C. Measure three feet from same corner along adjacent wall and mark.
D. Scribe an arc from three foot mark away from wall, using corner as center of arc.
E. Measure distance from four foot to arc line origin (3' mark). Distance should be 5'. If it is, walls are set true (90°).
F. If distance is greater than 5', measure 5' from four foot mark to a point on arc line and mark.
G. Stretch a chalkline from original corner across room. Draw taut across mark on arc and strike a line. This line is the true line of the room and will be the plaster line.
H. If distance is less than 5', walls intersect at an angle less than 90°. Move to adjacent corner and repeat above process.
I. True this corner if possible. If not, move to opposite wall regardless of straightness, and measure away from corner approximately 2".
J. From this point, lay out true lines to establish a square plaster line. Use 3-4-5 formula to lay out all corners and strike off new plaster line with chalk line.

II. Student square a room using right triangle method (3-4-5 method).

MASONRY

CONTENT TITLE: Preparation

SUB OBJECTIVE 4: The student will demonstrate ability to square a room using the square method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates squaring room using square method.

A. Clean room thoroughly.
B. Select straightest wall in room. This will be beginning point.
C. Position an 8' x 10' straightedge (absolutely straight 1 x 2, or 1 x 4 board or flatiron) on floor adjacent wall, and pushed into starting corner.
D. Use a large, wooden square (at least 6' x 6', securely braced, carefully laid out and fabricated with wood screws and glue) and push into corner against straightedge, firmly, to take up any slack.
E. Adjacent leg of square should run smoothly along base of other wall. If not, mark floor with sharp pencil or chalk to lay out a square line.
F. Similarly, square each corner of room which is not square.

II. Students square a room using the square method.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate proficiency (to the satisfaction of the instructor) in handling hawk and trowel, with minimum wastage of materials, to apply a scratch coat to a wall.

SOURCES OF INFORMATION

None

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Student Resource Manual

MASONRY

CONTENT TITLE: Scratch Coats

SUB OBJECTIVE 5: The student will demonstrate ability to proficiently handle hawk and trowel to apply a scratch coat of plaster to a prepared wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying a scratch coat.

A. Demonstrate correct procedure for holding hawk and trowel.

B. Demonstrate picking up plaster and applying it to a surface. Emphasize proper arm and wrist action and angle of tools.

C. Demonstrate raking and cross raking plaster coat after it has set.

II. Students apply a scratch coat.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to apply plaster to metal lath, paper-backed lath and concrete wall and ceiling systems.

SOURCES OF INFORMATION

Van Den Branden and Knowles, Plastering Skill and Practice, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1953.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Material estimation

Science

- Curing of cement
- Uses of muriatic acid

Communication Skills

- Student Resource Manual
- Making working drawings

MASONRY

CONTENT TITLE: Metal Lath Plastering

SUB OBJECTIVE 6: The student will demonstrate ability to apply a scratch coat to metal lath type wall and ceiling systems.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying plaster to metal lath wall and ceiling systems.

   A. Start in any corner and work from bottom to top.
   B. Pick up mortar and apply to lathing with light pressure. Trowel should be held at an angle to prevent mortar from screening through lath.
   C. Avoid overlapping strokes.
   D. Cover area from floor to maximum reach on all wall surfaces.
   E. Scratch and cross-score entire area before mortar sets.
   F. Reposition scaffolding. (Note: Although mason typically does not perform this work, he must know when it is to be done and how to determine if it has been done correctly.)
   G. Apply scratch coat to upper areas of walls.

II. Students plaster paperback lath wall and ceiling systems.

MASONRY

CONTENT TITLE: Paperback Lath Plastering

SUB OBJECTIVE 7: The student will demonstrate ability to apply a scratch coat to paperback lath type wall and ceiling systems.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates plastering paperback lath wall and ceiling systems.

   A. Start in any corner and work from bottom to top.
   B. Pick up mortar and apply with sufficient pressure on trowel to ensure flow of mortar around all exposed portions of lathing.
   C. Ensure that lathing is away from paper to ensure formation of good keys.
   D. Cover wall and ceiling area with scratch coat.
   E. Scratch coat before plaster sets.
   F. Reposition scaffolding and plaster upper walls and ceilings similarly.
   G. Allow scratch coat to cure.

II. Students plaster paperback lath wall and ceiling systems.

MASONRY

CONTENT TITLE: Plastering on Concrete

SUB OBJECTIVE 8: The student will demonstrate ability to apply a bond coat to a concrete surface.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying a bond coat of plaster to a concrete surface.

A. Mix up bond plaster.
B. Hack or otherwise roughen any smooth concrete surfaces to produce a surface more amenable to mechanical bonding.
C. Clean entire surface with a 10% solution of muriatic acid to remove any grease or other contaminants. Emphasize safety precautions to be observed when mixing and using muriatic acid.
D. Remove acid with plenty of water.
E. Keep concrete surface damp (not wet) while applying the scratch coat.
F. With firm, even pressure, apply a thin coat of bond plaster over the surface.
G. Scratch coat immediately to provide keys for following layers.
H. Allow scratch coat to set.

II. Students apply a bond coat of plaster to a concrete surface.

MASONRY

CONTENT TITLE: Plastering Concrete Blocks

SUB OBJECTIVE 9: The student will demonstrate ability to apply a scratch coat to a concrete block wall.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying plaster to concrete block walls.

A. Prepare basecoat or bond plaster.
B. Remove all loose brick mortar from concrete block walls.
C. Dampen area with water.
D. Starting in a corner, work upwards and apply with a firm, even pressure, a thin coat of scratch plaster to entire system.
E. Scratch plaster immediately as for any other system and allow plaster to set.

II. Students apply plaster to concrete block walls.

MASONRY

OVERALL OBJECTIVE: Given an area with scratch coat already applied and set, the student will demonstrate ability to install a dot and screed system to the wall preparatory to applying three coats of plaster.

SOURCES OF INFORMATION

Van Den Branden and Knowles, Plastering Skill and Practice, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1953.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Establishing dot grid

Communication Skills

- Student Resource Manual
- Vocabulary development

MASONRY

CONTENT TITLE: Dots

SUB OBJECTIVE 10: The student will demonstrate ability to position dots in a corner for subsequent screed making by the rod-and-level-from-a-base-ground method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing dots by the rod and-level-from-a-base-ground method.

A. Place a dot of mortar up approximately 6' from floor on both walls of the corner.
B. Embed a small block of wood into the dot, or place a piece of paper on it.
C. Lay rod against base ground in corner, vertically and hold a level against the rod.
D. Press inward against dot until rod is plumb as per level reading.
E. Repeat process for other corner angle.
F. Place dots on both corner angles near ceiling by plumbing rod from the 6' dots.

II. Students install dots by the rod and level from a base ground method.

MASONRY

CONTENT TITLE: Dots

SUB OBJECTIVE II: The student will demonstrate ability to position dots by the plumb bob method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates positioning dots by the plumb bob method.

A. Construct two plumb line gauges from 1 x 2 grounds stock.
B. Install dots on both walls of a corner near ceiling.
C. Hold one gauge at dot with plumb line running through cutout.
D. Allow plumb line to descend to base ground.
E. Position other gauge against base ground.
F. Push upper gauge into dot until plumb line just clears cutout in lower gauge.
G. Ensure that both gauges are held level during process.
H. Remove gauges and plumb line.
I. Trim excess plaster around indentation left from upper gauge until bottom of hole is level with rest of dot.
J. Plumb dot surface using a short level.

II. Students position dots by the plumb bob method.

MASONRY

CONTENT TITLE: Screed Installation

SUB OBJECTIVE I2: The student will demonstrate ability to rod screeds in a room utilizing established dots and existing base ground.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates rodding screeds into a room utilizing established dots and existing base ground.

A. Establish midpoint dots along upper portion of room, correct to base ground, as necessary. Use any method desired to establish dots. Allow to set.
B. Place dots horizontally with corner dots, evenly spaced, along upper portions of room.
C. Position a long straightedge (rod) along dots, from established dot to established dot.
D. Press rod into damp dots until rod is firmly seated against established dots.
E. Trowel in a slightly excess amount of brown coat mix between base ground and dot.
F. Rod out excess material.
G. Fill in any low spots with more plaster.
H. Rerod corner.
I. Continue to rod screed between dots along wall. Allow to set. Wall is now ready for application of plaster.

II. Students rod screeds into a room utilizing established dots and existing base ground.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to install a dot and screed system on a prepared ceiling.

SOURCES OF INFORMATION

Van Den Branden and Knowles, Plastering Skill and Practice, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1953.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

Related safety
- Working overhead and on platforms

Technical literature

MASONRY

CONTENT TITLE: Ceiling Dot and Screed Systems

SUB OBJECTIVE 13: The student will demonstrate ability to fabricate and use a water level.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates fabricating and using a water level.

A. Obtain fifty foot length of 3/8" or 1/2" water hose without fittings.
B. Insert a 10" or 12" boiler gauge glass at each end of hose.
C. Siphon water into hose until all air has been removed. Trap water in hose and bring boiler glasses level with each other, up to ceiling level.
D. Mark water level. Always observe eye level with water; mark bottom of minuscus curve. Allow some water out if hose is too full for accurate measurement.
E. Bring glasses, one to each end of room, up to level of ceiling and adjacent wall. Mark correct level.
F. With one end of hose remaining at mark, move other end, at six foot intervals, along wall and mark until length of room is spanned.
G. Check alignment of these marks with straightedge. Correct those not in alignment.

II. Students fabricate and use a water level.

MASONRY

CONTENT TITLE: Ceiling Dots

SUB OBJECTIVE 14: The student will demonstrate ability to install and set dots on a ceiling and rod in screeds between the dots.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates setting ceiling dots.

A. Starting at end of wall, place plaster dots on ceiling above each level mark.
B. Place a piece of paper on each dot to keep gauge from sticking to dot.
C. Position one leg of gauge up to level line on wall. Press other gauge leg into plaster dot and press to level. Maintain levelness of each operation by holding a level on top of the horizontal leg.
D. Trim excess material from dot.

II. Instructor demonstrates rodding in screeds between the dots.

A. Trowel on a brown coat mix between the dots.
B. Rod out screeds between dots.
C. Fill in low spots with more plaster.
D. Rerod screeds as necessary.

III. Students set ceiling dots and rod in screeds between dots.

MASONRY

OVERALL OBJECTIVE: Given a wall and ceiling area where screeds have been installed, the student will demonstrate ability to apply a smooth, even brown coat to the total area.

SOURCES OF INFORMATION

Van Den Branden and Knowles, Plastering Skill and Practice, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1953.

ACADEMIC RELATED THEORY AND INFORMATION

Communication Skills

- Vocabulary development
- Student Resource Manual

MASONRY

CONTENT TITLE: Brown Coat

SUB OBJECTIVE 15: The student will demonstrate ability to apply the brown coat to a wall and ceiling system where screeds have been previously installed.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying brown coat.

A. Spread brown coat thickly so that it stands out to face of screeds.
B. Hold rod against screeds and move it forward at a slight angle so that mortar will fall free of rod.
C. Spot up depressions that remain by adding small amounts of mortar to them.
D. Rerod surface.
E. Flatten ridges left by rod by darbying total area vertically and horizontally.
F. Spot up any flawed areas.

II. Students apply a brown coat.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to line, dot and strip a beam and to apply the brown coat to soffit and beam sides and walls of recessed windows.

SOURCES OF INFORMATION

Van Den Branden and Knowles, Plastering Skill and Practice, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1953.

ACADEMIC RELATED THEORY AND INFORMATION

Science	Communication Skills
Reason for expansion joints	Student Resource Manual

MASONRY

CONTENT TITLE: Beam Dots

SUB OBJECTIVE 16: The student will demonstrate ability to install dots on beams and soffits.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing dots on beams or soffits.

A. Dot in pencil sized gauging sticks at two foot intervals along beam soffit. Allow these dots to set.
B. From a reference point such as an adjacent finished wall or beam, measure to each stick on the soffit and arbitrarily mark the same distance on each.
C. Measure from a reference point, such as a finished wall or adjacent beam, an established distance to each stick on the soffit. Mark each stick and cut off at the mark.
D. Press in a dot over each stick, using stick's end as a stop gauge.
E. Plumb each dot with a level.
F. Place dots on opposite side of beam and guage beam to a predetermined thickness from plumbed dot surfaces. Stick a scrap of paper on the end of each dot.
G. Using a level, plumb each dot on opposite beam side with a level.

II. Students install dots on beams or soffits.

CONTENT TITLE: Beam Strips

SUB OBJECTIVE 17: The student will demonstrate ability to apply the brown coat and install beam strips on beams and soffits.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing beam strips on beams and soffits.

A. Brown in between dots on both sides of beam.
B. Allow brown coat to set.
C. Establish water level line along beam sides above soffit at a predetermined point, depending on strip stock width.
D. Place high-gauge putty and plaster dabs about 2' apart along the line where strip is to be installed.
E. Nail up beam strips on bottom of water level line.
F. Brown in beam soffit to edge of strips.
G. Leave strips on beam for putty coat application.

II. Students install beam strips on beams and soffits.

CONTENT TITLE: Recessed Windows

SUB OBJECTIVE 18: The student will demonstrate ability to brown in the window returns.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates browning in window returns.

A. Place a rod vertically to one side of the window return.
B. Plumb rod with a level.
C. Brown in returns with a short rod using the larger rod as a ground.
D. Remove rod and work the corners.
E. Spot the entire area.
F. Darby the returns.

II. Students brown in window returns

MASONRY

OVERALL OBJECTIVE: On a given area having a true plane and a cured brown coat, a two-student team will apply a putty coat to the surfaces. Each student will also demonstrate ability to apply various finish colors, finishes and textures.

SOURCES OF INFORMATION

Dalton, Byron W., Practical Plastering and Related Subjects, (Byron W. Dalton: 330 South Marshfield Avenue, Chicago, Illinois), 1949.

Van Den Branden and Knowles, Plastering Skill and Practice (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1953.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review math requirements for job entry and/or higher education

Science

- Modern methods of applying plaster (pumps)
- Modular plaster units and systems prefabrication

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Vocabulary development
- Review of communication skill requirements for job entry and/or higher education
- Review of job and career opportunities in plastering

CONTENT TITLE: Putty Coat

SUB OBJECTIVE 19: The student will demonstrate ability to work in a two-man team to apply a putty coat to a cured brown coat surface.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor outlines steps in applying the putty coat.

A. Discuss general pattern of operation.
B. Demonstrate rodding out plaster to straighten corners.
C. Demonstrate applying doubling up coat.
D. Demonstrate floating angles.
E. Demonstrate applying doubling up coat between angles.
F. Demonstrate refloating corners.
G. Demonstrate wetting or tightening total surface area.
H. Demonstrate brushing surface with water.

II. Students work in teams to apply the putty coat.

CONTENT TITLE: Finishes

SUB OBJECTIVE 20: The student will demonstrate ability to apply a sand finish to a surface.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying a sand finish.

A. Point out that sand finish is applied, in general, similarly to putty coat.
B. Demonstrate difference in treatment, by allowing surface to stiffen to a point where the glossy sheen disappears.
C. Demonstrate floating surface with a large wood float, followed by working with a rubber faced float for the finish work.

II. Students apply a sand finish.

MASONRY

CONTENT TITLE: Finishes

SUB OBJECTIVE 21: The student will demonstrate ability to apply a Keene's Cement finish.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying a Keene's Cement finish.

A. Apply cement as you would a putty coat.
B. Using very little water, trowel surface lightly after application.
C. Allow work to stand undisturbed for about an hour.
D. Trowel area again, though it will be set hard.
E. Do not apply in layers more than 1/8" thick.

II. Students apply a Keene's Cement finish.

CONTENT TITLE: Finishes

SUB OBJECTIVE 22: The student will demonstrate ability to apply an interior Portland Cement finish.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor discusses use of Portland Cement and demonstrates applying an interior Portland Cement finish.

   A. Discuss differences in handling Portland Cement.
   B. Mention that heavily worked Portland Cement finishes tend to be fragile and should not be selected for areas exposed to extreme weather conditions or heavy physical abuse.
   C. Point out that in general, application is similar to putty finishes.
   D. Demonstrate floating surface with a wood float.
   E. Demonstrate floating surfaces with a rubber-faced float for the finish work.

II. Students apply an interior Portland Cement finish.

MASONRY

CONTENT TITLE: Finishes

SUB OBJECTIVE 23: The student will demonstrate ability to apply a color finish.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates various methods of applying color to the plaster finishes.

   A. Do not water trowel surfaces.
   B. Produce a solid color finish by mixing color with putty coat.
   C. Produce patterned effects by shaking color onto surfaces. Trowel the surfaces.
   D. Produce marble effects by placing two or three colors with the plaster on the hawk. Apply it as though it were one color.

II. Students apply color to plaster finishes.

MASONRY

CONTENT TITLE: Finishes

SUB OBJECTIVE 24: The student will demonstrate ability to apply various textured finishes.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates various methods of applying texture to final finishes.

   A. Do not trowel last putty coat to a smooth finish.
   B. Begin texture work before last putty coat dries.
   C. Utilize the brush stipple by daubing it on walls or ceiling, or moving it in a circular motion to impart a swirl design.
   D. Use a sponge for a uniform effect.
   E. Produce a travertine effect by applying the last mortar coat thickly. Jab the mortar with a whisk broom or wire brush. Trowel down lightly before material begins to harden.
   F. Produce arced effects by moving and pressing the top edge of the trowel in a short arc.

II. Students apply textures to final finishes.

TILE AND TERRAZZO WORKING

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MASONRY

OVERALL OBJECTIVE: The student will demonstrate ability to cut and fit tile to desired sizes and to break tile to a desired length.

SOURCES OF INFORMATION

Brann, Donald R., How to Lay Ceramic Tile, (Directions Simplified, Inc.: Briarcliff Manor, New York), 1970.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Measuring
  - Whole numbers
  - Fractions
  - Decimals
- Material and Tool sizing

Science

- Properties of ceramic tile

Communication Skills

- Blueprint reading
- Student Resource Manual
- Related safety
  - Using power equipment

MASONRY

CONTENT TITLE: Cutting and Breaking Tile

SUB OBJECTIVE I: The student will demonstrate ability to cut tile to a desired length.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates cutting a piece of tile to the desired length.

   A. Mark off the length of tile to be cut with a ruler and pencil.
   B. Take a pencil and a straightedge; mark off a line from edge to edge, on both sides of the tile.
   C. Scratch the glazed surface of the tile with a glass cutter.
   D. Lay the tile down on an 8 penny finishing nail, with the scratched line directly over the nail.
   E. Press the tile with hands on both sides of the tile to break it.
   F. Smooth the edges with a carborundum stone or electric grinding wheel.

II. Students cut piece of tile to desired length.

MASONRY

CONTENT TITLE: Cutting and Breaking Tile

SUB OBJECTIVE 2: The student will demonstrate ability to cut and fit tile around a pipe.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates cutting and fitting tile around a pipe.

A. Set the tile in place.
B. Take a pencil and a straightedge; mark off the pipe's centerline on the face.
C. Take a glass cutter and scratch out this line.
D. Mark off the outline of the pipe with a pencil.
E. Scratch the outline of the pipe with a glass cutter.
F. Nibble the area outlined with glass pliers or glass nippers. Take small bites at each stop.
G. Smooth the edge of the cut with carborundum or an electric grinding wheel.

II. Students will cut and fit tile around a pipe.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate the ability to set ceramic tile on various vertical surfaces using mastic adhesive and built up methods.

SOURCES OF INFORMATION

Brann, Donald R., How to Lay Ceramic Tile, (Directions Simplified, Inc.: Briarcliff Manor, New York), 1970.

Handbook for Ceramic Tile Installation, (Tile Council of America: P. O. Box 326, Princeton, New Jersey 08540), 1972.

Tilesetting Workbook, 2nd ed., (California State Department of Education: 721 Capitol Mall, Sacramento, California 95814), 1964.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Level, plumb and square

Science

- Adhesives and primers

Communication Skills

- Student Resource Manual
- Vocabulary development
- Manufacturer's literature
- Catalog work
- Related safety
  - Working metal lath

MASONRY

CONTENT TITLE: Tiling Vertical Surfaces

SUB OBJECTIVE 3: The student will demonstrate laying out and preparing a vertical wall surface for setting ceramic tile with mastic adhesive.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying out an area around a tub prior to applying mastic adhesive. (Note: Use dry tiles with mastic adhesive.)

A. Check the edge of the tub with a spirit level to determine its highest point.
B. Take the highest point and draw a perpendicular line 4-3/8" high (or the width of the tile plus 3/8").
C. Use the spirit level to draw this line 4-3/8" above the highest point all the way around the tub.
D. Apply primer paint; let it dry.
E. Apply a thin coat of adhesive to a tile and press it into the most visible corner, so that the top of each tile is level with the guide line.
F. Butt each tile squarely against the spacer lugs on its predecessor.
G. Cut single tiles to fit around the edge of the tub.
H. Check the first course with the level and make any necessary adjustments.
I. Spread a thin layer of adhesive on the adjacent wall with a notched trowel.
J. Continue process.

II. Students lay out and tile an area around a bathtub.

MASONRY

CONTENT TITLE: Setting Tile on Vertical Surfaces

SUB OBJECTIVE 4: The student will demonstrate ability to install wet grout on vertically installed ceramic tile.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates mixing and i[illegible]g wet grout on ceramic tile walls.

A. Allow tile to set 24 to 36 hours before grouting.
B. Wet joints with small sponge and water.
C. Use a clean bucket and clean water. Wear rubber gloves.
D. Mix in neat Portland cement until mixture has consistency of thick cream.
E. Dip a sponge or brush in the mixture and wipe it over the face of the tiles; this will fill the joints.
F. Let grout set a few minutes.
G. Work the grout into joints with a toothbrush handle drawn down the joints.
H. Let grout begin setting.
I. Sponge face of tile with clean water.
J. Polish tile surface.
K. Caulk the joint between the tile and the tub.
L. Spray walls with fine mist of water for 3 or 4 days.

II. Students mix and install grout on vertical ceramic walls.

MASONRY

CONTENT TITLE: Setting Tile on Vertical Surfaces

SUB OBJECTIVE 5: The student will prepare a vertical surface using the built-up method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing an interior wall using the built-up technique.

A. Remove loose paint or plaster; wash off old paint with tri-sodium phosphate.
B. Apply strips of 15 lb. building felt to the wall surface; overlap strips by 2".
C. Attach furring strips if metal lath cannot be attached to the wall.
D. Apply metal lath to the felt; overlap by 2" at least.
E. Sever lath at all expansion joints.
F. Apply scratch coat with smooth, even trowel strokes.
G. Let scratch coat dry.
H. Check the scratch coat with a spirit level.
I. If scratch coat varies more than 1/4" per 8", apply a leveling coat.
J. Allow scratch coat to dry 24 hours to 10 days.
K. Mix dry set mortar following manufacturer's instructions.
L. Apply mortar with hawk and trowel with long, even trowel strokes.
M. Let mortar set.
N. Apply float coat with long, even trowel strokes.
O. Remove the screed strips.
P. Trowel in enough mortar to fill spaces left by screed strips.
Q. Remove excess mortar with 12" or longer straightedge.

II. Students prepare vertical surface using built-up technique.

MASONRY

CONTENT TITLE: Setting Tile on Vertical Surfaces

SUB OBJECTIVE 6: The student will demonstrate ability to apply ceramic tile to a vertical surface using the built-up method.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates applying ceramic tile to a built-up wall.

A. Dash the float coat lightly with water.
B. Soak the tile in water for 1/2 hour.
C. Mix pure cement and water; allow it to sit for 20 minutes.
D. Remix it to a creamy consistency.
E. Trowel on the cement to 1/32" to 1/16" consistency. Use long, even trowel strokes.
F. Flatten the cement with a straightedge.
G. Place the first row of tile on a level screed strip.
H. Seat the tiles with a flat, rubber-covered block.
I. Lay four rows at a time.
J. Repeat the process.
K. Apply grout.

II. Students apply ceramic tile to a built-up wall.

MASONRY

OVERALL OBJECTIVE: The student will be able to lay out and set tile floors by a variety of methods.

SOURCES OF INFORMATION

Tilesetting Workbook, 2nd ed., (California State Department of Education: 721 Capitol Mall, Sacramento, California 95814), 1964.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Ratios and proportions
- Degrees and angles

Communication Skills

- Student Resource Manual
- Related safety - working with cement materials
- Manufacturer's literature
- Vocabulary development
- Review of job and career opportunities in tile working industry
  - Job
  - Apprenticeship
  - Higher education

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MASONRY

CONTENT TITLE: Laying Out and Setting Tile Floors

SUB OBJECTIVE 7: The student will demonstrate ability to prepare a floor for the installation of ceramic tile by building a mortar setting bed.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing a floor to receive ceramic tile.

A. Measure the subfloor carefully.
B. Sweep off all loose trash.
C. Place masking tape screed strips on the floor.
D. Mix mortar--generally one part of Portland cement to five or six parts of sand.
E. Apply mortar with smooth, even trowel strokes to an area small enough to be covered before setting occurs.
F. Mortar the floor to a thickness of 1" plus the greatest deviation from level (usually 1/4").
G. Dust dry Portland cement powder over mortar bed. Make sure it wets from the bottom.

II. Student prepares floor to receive tile.

MASONRY

CONTENT TITLE: Laying Tile on Floors

SUB OBJECTIVE 8: The student will demonstrate ability to lay a ceramic tile floor over an already prepared subfloor.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying a ceramic tile floor over an already prepared subfloor.

A. Begin at the far end of the room or at the far intersection of two right-angled walls.
B. Trowel on mortar.
C. Set enough tile to support a kneeling board.
D. Beat tile in with a flat, rubber covered block.
E. Remove chips and flakes.
F. Lay out a kneeling board--be sure it is not more than 12" wide.
G. Do not stand or kneel on the edge of the board.
H. Continue laying tile.
I. Repeat process until room is covered.
J. Apply grout.

II. Students lay tile.

MASONRY

CONTENT TITLE: Setting Tile Floors

SUB OBJECTIVE 9: The student will demonstrate capacity to set a quarry tile floor without legs.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates setting a quarry tile floor without legs.

A. Lay out a story pole--a straightedge 2 x 4 as long as 10 or 15 tile plus their adjacent joints.
B. Mark off the tile and joint spaces on the story pole.
C. Cut two short layout sticks the length of three tile plus those joints.
D. Attach a taut string or chalkline parallel to the longest or master wall and one tile width away from it and one or two inches above the floor.
E. Set the story pole against, and perpendicular to, the base of the master wall.
F. Attach a nail to the story pole where it crosses the chalkline.
G. Lay one row of tile against the story pole; be sure the top edges of each tile fit the appropriate marks on the story pole.
H. Move the story pole up three rows and lay out the layout sticks--one at each end of the story pole and perpendicular to the master wall and to the story pole.
I. Lay a row of tile against the story pole; be sure the top edges of each tile fit the appropriate marks on the story pole.
J. Fill in the two rows between by eyeing them in.
K. Repeat the process.
L. Apply grout.

II. Students lay out a quarry tile floor.

MASONRY

CONTENT TITLE: Flooring with Tile

SUB OBJECTIVE 10: The student will demonstrate the capacity to set a quarry tile floor with legs.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates laying a quarry tile floor with legs.

A. Make a layout stick or story pole--a straightedge 2 x 4 as long at 10 or 15 tile plus the adjacent joints. Mark off appropriate spaces for the tile and joints.

B. Lay out a strip of mortar one tile wide and parallel to the master wall.

C. Lay out the second course of mortar and tile against one of the adjacent and perpendicular walls; use the story pole as a guide to placing the tile.

D. Move the story pole over 10, 12, or 15 feet and start a second leg, parallel to the second course and perpendicular to the first course. (Use a T-square to determine the perpendicularity of the story pole.)

E. Repeat filling in the gaps between the legs.

F. Apply grout.

II. Students lay a quarry tile floor with legs.

MASONRY

CONTENT TITLE: Floor with Ceramic Tile

SUB OBJECTIVE II: The student will demonstrate ability to set a ceramic tile floor with mastic adhesive.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates setting a ceramic tile floor with mastic adhesive.

   A. Remove paint, linoleum, asphalt tile, etc. Fasten down loose boards.
   B. Remove doorway saddle and wallboard molding with a crowbar.
   C. Drain radiators and move them or prop them up with 2 x 4's.
   D. Paint the floor with primer and let it dry.
   E. Apply adhesive with a notched trowel; use firm even strokes.
   F. Press tiles into place with slight sliding motion.
   G. Beat tile into place with a flat, rubber-covered block.
   H. Apply grout after 24 hours. Use rubber gloves.

II. Students set ceramic tile to a floor using mastic adhesive.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate the ability to prepare an underbed and to install and cure a Portland cement floor.

SOURCES OF INFORMATION

Schmidt, John L., et.al., Construction: Principles, Materials and Methods, (American Savings and Loan Institute Press: III East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers, Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Science

- Properties of terrazzo

Communication Skills

- Manufacturer's literature
- Student Resource Manual
- Vocabulary development

MASONRY

CONTENT TITLE: Unbonded Terrazzo Installation

SUB OBJECTIVE 12: The student will demonstrate ability to prepare a concrete subfloor for unbonded terrazzo installation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates the ability to prepare a concrete subfloor.

   A. Clear the subfloor of loose and extraneous material.
   B. Be sure the subfloor is smooth-troweled and at least 21 days old.

II. Students prepare a concrete subfloor.

MASONRY

CONTENT TITLE: Unbonded Terrazzo Installation

SUB OBJECTIVE 13: The student will demonstrate ability to prepare an underbed for unbonded terrazzo installation.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing a subfloor for unbonded terrazzo installation.

A. Spread a layer of sand 1/16" to 1/4" deep over the subfloor.
B. Screed the sand with a straightedge; make sure the sand is firmly packed and of uniform thickness.
C. Lay out an unbroken polyethylene membrane over the sand layer; overlap membrane joints by 4".
D. Lay out metal reinforcing mesh; overlap the mesh strips by two mesh spaces.
E. Wire the mesh strips together.
F. Mix one part of Portland cement to 4 or 5 parts of sand.
G. Add enough water to make a good stiff mortar.
H. Dampen the polyethylene membrane so that the mortar will lie on a wet surface.
I. Prepare windows.
J. Place the mortar.
K. Raise the wire mesh so that about 1" of mortar is below the mesh.
L. Screed and trowel the mortar.
M. Be sure the topping and underbed are together 2-1/2" thick.
N. Let the underbed set until it is semi-plastic.

II. Student prepares a subfloor.

CONTENT TITLE: Unbonded Terrazzo Installation

SUB OBJECTIVE 14: The student will demonstrate the capacity to install divider strips in a newly-laid underbed.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates installing divider strips in a newly-laid underbed.

   A. Set long strips in place, not more than 6' o.c.
   B. Align strips with a straightedge.
   C. Level each strip so that it is even with the finished floor elevation.
   D. Trowel each strip along the edge to embed it in the semi-plastic underbed mortar.

II. Students installs divider strips in a newly-laid underbed.

CONTENT TITLE: Unbonded Terrazzo

SUB OBJECTIVE 15: The student will demonstrate ability to cure a cement underbed and prepare it to receive topping.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates curing and preparing a cement underbed.

   A. Allow the underbed to harden 12-24 hours.
   B. Mix neat cement to the consistency of thick cream.
   C. Brown a light layer of cement onto the underbed.

II. Students cure and prepare a cement underbed.

CONTENT TITLE: Unbonded Terrazzo

SUB OBJECTIVE 16: The student will demonstrate ability to mix and place a terrazzo topping.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates mixing and placing a terrazzo topping.

A. Mix dry ingredients--there should be 200 lbs. of marble chips to each 94 lbs. of Portland cement.
B. Add water to the dry mix in a power cement mixer. Use 5 to 5-1/2 gallons of water per bag of mix.
C. Place the topping onto the underbed.
D. Trowel the mixture so that it is even with the tops of the divider strips.
E. Wet down additional chips similar to the chips in the topping mix.
F. Trowel in the extra chips.
G. Roll the surface with a heavy roller to squeeze out excess water.
H. Trowel and smooth the surface a second time.

II. Students mix and place a terrazzo topping.

CONTENT TITLE: Unbonded Terrazzo Floors

SUB OBJECTIVE 17: The student will demonstrate ability to finish a terrazzo floor topping.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates finishing a terrazzo floor topping.

A. Wet cure the topping for 3 to 7 days by placing or with a curing compound.
B. Grind the topping with a terrazzo grinding machine using a no. 24 grinding stone.
C. Be sure the topping surface is covered with water.
D. Rinse the surface with water.
E. Mix neat Portland cement to the consistency of thick cream.
F. Trowel this mixture over the surface; fill all hollows.
G. Wet cure again for 3 days with watertight cover or curing compound.
H. Use a floor polishing machine with a no. 80 grinding stone to remove grout surface (except in hollows).
I. Use neutral floor cleaner.
J. Rinse the floor with water.
K. Dry the floor.
L. Treat the surface with a sealing compound.
M. Cover the floor with building paper until it is ready for use.

II. Students finish a terrazzo floor.

MASONRY

OVERALL OBJECTIVE: The student will demonstrate the capacity to lay out and install a terrazzo floor using various bonded methods of application.

SOURCES OF INFORMATION

Schmidt, John L., et.al., Construction: Principles, Materials, and Methods, (American Savings and Loan Institute Press: 111 East Wacker Drive, Chicago, Illinois 60601; or Interstate Printers and Publishers Inc.: 19 North Jackson Street, Danville, Illinois 61832), 1972.

ACADEMIC RELATED THEORY AND INFORMATION

Math

- Review math requirements for job entry and/or higher education

Science

- Terrazzo bonding methods and materials

Communication Skills

- Manufacturer's literature
- Related safety
  - Equipment usage
  - Special resins and thinners
- Vocabulary development
- Review communication skills requirements for job entry and/or higher education
- Review job and career opportunities in terrazzo

MASONRY

CONTENT TITLE: Bonded Terrazzo Tile

SUB OBJECTIVE 18: The student will demonstrate ability to prepare a floor for thinset terrazzo application.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing a concrete subfloor prior to thinset application.

A. Make sure the concrete is smooth-troweled and at least 21 days old.
B. Level the subfloor to make sure that there is no more than 1/3" variation for each 10' of surface.
C. Lay out and install T-shaped divider strips each 15' to 20' o.c.
D. Fasten divider strips with recommended adhesive.
E. Mix resinous binder and chips following manufacturer's recommendations.
F. Pour the mixture.
G. Trowel the mixture.
H. Add extra chips as needed.
I. Trowel as needed
J. Let it set for 24 hours to 3 days.
K. Wet the surface.
L. Grind with terrazzo grinder and recommended stone.

II. Students install terrazzo by thinset method.

CONTENT TITLE: Bonded Terrazzo Floor

SUB OBJECTIVE 19: The student will demonstrate ability to prepare and install a monolithic terrazzo floor on concrete.

SUGGESTED ACTIVITIES: (Students and Teachers)

I. Instructor demonstrates preparing and installing a monolithic terrazzo floor on concrete.

A. Make sure the subfloor is at least 3-5/8" thick.
B. Brush the surface with a wire broom to prepare a strong bonding surface.
C. Cut the concrete with a jointing tool every 15' to 20'.
D. Install control joints.
E. Wash the subfloor with detergents.
F. Pond the floor overnight.
G. Squeeze off the water.
H. Mix water and neat Portland cement to a thick, creamy consistency.
I. Add pigment to cement to color it like the topping.
J. Broom the cement onto the subfloor.
K. Mix the topping in a cement mixer using 5 to 5-1/2 gallons of water.
L. Pour the mixture.
M. Spread and trowel the mixture.
N. Seed the mixture with additional chips.
O. Trowel the chips into the mixture.
P. Roll the surface to squeeze out excess water.
Q. Trowel the surface smooth.
R. Wet cure 3-7 days.
S. Pond the surface.
T. Grind the surface with no. 24 abrasive stone.
U. Grind again with no. 80 abrasive stone.
V. Wet down the surface to remove loose chips and fragments.
W. Mix and trowel grout.

Continued . . .

CONTENT TITLE: Bonded Terrazzo Floor (Continued)

SUB OBJECTIVE 19: The student will demonstrate ability to prepare and install a monolithic terrazzo floor on concrete.

SUGGESTED ACTIVITIES: (Students and Teachers)

X. Wet cure three days.
Y. Grind with no. 80 abrasive stone; leave grout in terrazzo hollows.
Z. Clean with a neutral liquid cleaner; rinse and dry. Cover until ready for use.

II. Students install monolithic terrazzo floor.

APPENDIX

MASONRY

LESSON PLAN SAMPLE

OVERALL OBJECTIVE:	The student will demonstrate ability to lay up and lay out brickwork commonly encountered in gardens such as planters, patios and the like.
SUB OBJECTIVE:	To do flat brickwork such as is used for floors, walks, patios and hearths.
TOOLS AND MATERIALS:	Brick, sand, spirit level, trowel, rake, screed.
I. Preparation:	Read Bricklayer's Vocational Training Textbook, pp. 50-53; Audels Masons and Builders Guide #1, pp. 266W-266Z.
II. Presentation:	Demonstrate preparing a sand bed and laying bricks in different patterns.
III. Application:	Student prepares bed and lays bricks in various patterns.
IV. Performance Tests:	

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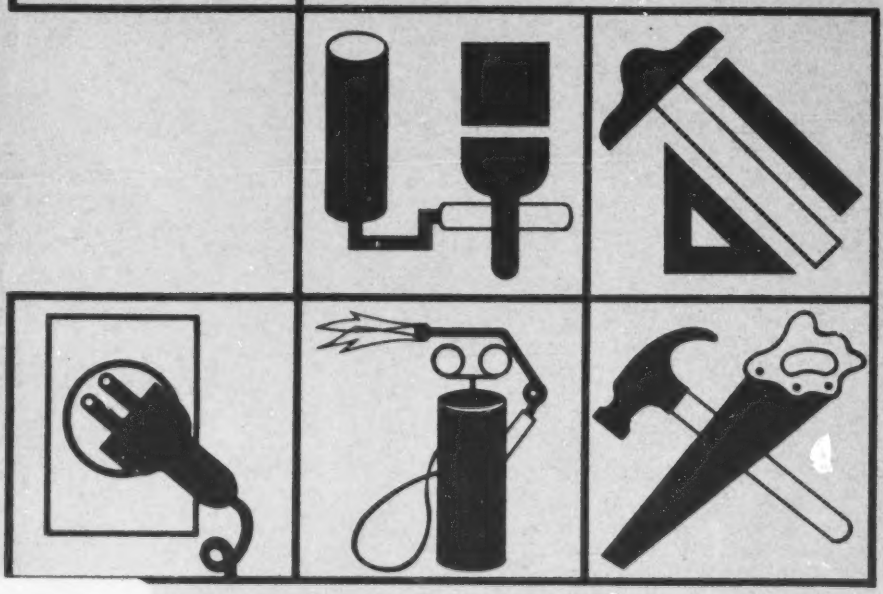
MASONRY



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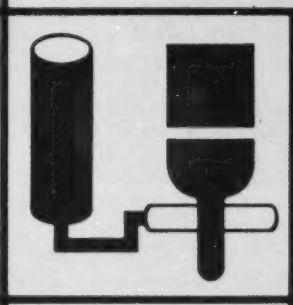

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TEXAS EDUCATION AGENCY

AUSTIN, TEXAS

1975

This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

Exploration Level:

Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

Occupational Preparation Level:

Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
Metal - Student Manual
Metal - Instructor's Guide
Electricity - Student Manual
Electricity - Instructor's Guide
Masonry - Student Manual
Masonry - Instructor's Guide

In addition, there is an Articulation Guide designed for these instructional materials in construction.

Articulation Guide - Construction Industry Series

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MASONRY

INTRODUCTION

This manual will assist you in several instructional programs in construction masonry work. For many, the skills and knowledge acquired in one or more of these masonry training programs will lead to a job in the construction industry after high school graduation. Others may decide to go on to a junior or senior college for further education. In any event, you have made a basic decision to prepare yourself for a career in the construction industry.

Your education in masonry will be broad enough to include a number of job possibilities. The skills and knowledge you will learn can be applied to other areas within the construction industry and even to other industries. For this reason, you should not feel "locked into" any masonry course. Whatever jobs you may eventually hold in construction, in the trades, technical, professional, management or distribution areas, your experiences and preparation in masonry classes will help. You will be leaving high school with more than just a diploma, and you'll be starting out in front, because your preparation will offer much to an employer.

So while you are still in school, look around to see what is offered and how it can advance your future career in construction. Math classes will offer experiences in computations, whole numbers, fractions and decimals. The ability to measure with accuracy is a skill demanded by a technical society.

English or communication skill classes will strengthen your abilities to write, talk, draw, read and listen. These, too, are valuable tools for you to get, hold and advance on the kind of occupation you want.

Science classes will increase your understanding of the world around us. This understanding is important and becoming more important to anyone in construction. Whether it be an electromagnetic force, certain insulation qualities of materials, or hydraulics or ecology, science classes will help deepen your awareness and understanding of the work you do and the materials you use.

Social science courses will assist your broad understanding of our political, social and economic systems. To appreciate the past will increase your awareness of the changes which affect all of our lives today.

Other areas which can help you, and areas which are probably available to you through your high school, are student clubs and associations — VICA, DECA, FFA, FHA, OEA and FBLA. These clubs help many students develop leadership skills and pride in work.

All of these areas described above are probably available at your high school. There are many others that can help you make a career decision, and hopefully you're one of those students who has chosen your career area after study and exploration in school.

Good luck to you in the growing area of construction!

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BRICK AND BLOCK LAYING

Bricklayers (or brickmasons) construct walls, partitions, fireplaces, patios, chimneys and other structures. They may use brick, concrete, cinder block or other materials, but whatever the material the work is essentially the same.

BRICK MATERIALS

First we will look at the most common materials used by brickmasons.

Building brick is made of ordinary clays or shales and burned in the usual manner in kilns. These bricks do not have special scorings or markings, and are not produced in any special color or surface texture. Building brick is also known as hard kiln run brick. It is generally used for backing in solid or cavity brick walls.

Face brick are used in the exposed face of a wall and are higher in quality than backup brick. They have better durability and appearance. The most common colors of face brick are various shades of brown, red, gray, yellow and white.

Clinker brick is overburned in the kilns. This type of brick is usually hard and durable and may be irregular in shape.

Press brick is made by the dry press process. It has regular smooth faces, sharp edges and perfectly square corners. Ordinarily all press brick are used as face brick.

Glazed brick has one surface of each brick glazed in white or another color. The ceramic glazing consists of mineral ingredients which fuse together in a glass-like coating during burning. This type of brick is particularly suitable for walls or partitions in hospitals, dairies, laboratories or other buildings where cleanliness and ease of cleaning is necessary.

Fire brick is made of a special type of fire clay which will withstand the high temperatures of fireplaces, boilers and similar usages without cracking or decomposing. Fire brick is generally larger than regular structural brick and is often hand molded.

Cored brick is molded with rows of holes extending through their beds to reduce weight. There is no significant difference between the strength of walls constructed with cored bricks and those constructed with solid brick.

Sand-lime brick is a lean mixture of slaked lime and fine silicious sand molded under mechanical pressure and hardened under steam pressure.

MORTAR FOR BRICK MASONRY

Mortar is used to bond brick together and correct irregularities in the dimensions and shape of the brick. It is composed of cement, lime and sand, in proportions varying according to the use of the mortar.

Type M may be made two ways: (a) 1 part Portland cement, 1/4 part hydrated lime or lime putty and 3 parts sand; or (b) 1 part Portland cement, 1 part type II masonry cement and 6 parts sand. This mortar is suitable for general use and is recommended specifically for masonry below grade and in concrete with earth, such as foundations, retaining walls and walks.

Type S is (a) 1 part Portland cement, 1/2 part hydrated lime or lime putty and 4-1/2 parts sand; or (b) 1/2 part Portland cement, 1 part type II masonry cement and 4-1/2 parts sand. This mortar is also suitable for general use and is recommended where high resistance to lateral forces is required.

Type N is (a) 1 part Portland cement, 1 part hydrated lime or lime putty and 6 parts sand; or (b) 1 part type II masonry cement and 3 parts sand. This mortar is suitable for general use in exposed masonry above ground and is recommended specifically for exterior walls subjected to severe weather.

Type O is (a) 1 part Portland cement, 2 parts hydrated lime or lime putty and 9 parts sand; or (b) 1 part type I or type II masonry cement and 3 part sand. This mortar is recommended for non-load-bearing walls of solid units where the compressive stresses do not exceed 100 pounds per square inch and the masonry will not be subjected to freezing and thawing in the presence of excessive moisture.

METAL TIES

Metal ties are used to tie the brick on the outside face of the wall to the backing courses. These are used when no header courses are installed, but are not as satisfactory as header courses.

FLASHING

Flashing is the waterproof membrane placed in masonry which keeps out water and directs it to the outside wall. Copper, lead, aluminum, galvanized iron and bituminous roofing paper are materials that may be used for the flashing membrane.

CONCRETE BLOCKS

Concrete building units are made in sizes and shapes to fit different construction needs. Units are made in full and half-length

sizes. The sizes are usually referred to by their nominal dimensions. A unit measuring 7 and 5/8 inches wide, 7 and 5/8 inches high and 15 and 5/8 inches long is referred to as an 8 x 8 x 16 inch unit. When it is laid in a wall with 3/8 inch mortar joints, the unit will occupy a space exactly 16 inches long and 8 inches high. Besides the basic 8 x 8 x 16 units, there are other units which are used as much as cut bricks are in brick masonry.

The sides and the recessed ends of a concrete block are called the *shell*, and the material which forms the partitions between the cores is called the *web*. Each of the long sides of a block is called a *face shell*, and each of the recessed ends is called an *end shell*. Bed joints on first courses and bed joints in column construction are mortared by spreading a 1 inch layer of mortar. This is called "full mortar bedding." For most other bed joints, only the upper edges of the face shells need to be mortared. This is called "face shell mortar bedding."

The vertical ends of the face shells, on either side of the end shells, are called the edges. Head joints may be mortared by buttering one edge on the block being laid and the opposite edge on the block already in place.

Corner block is laid at a corner or at some similar point where a smooth, rather than a recessed end is required.

Header block is used in a backing course placed behind a brick face tier header course. Part of the block is cut away to admit the brick headers.

Lintel block is "U" or "W" shaped and is used in constructing horizontal beams or lintels.

Partition block is usually 4 or 6 inches thick and is used in construction of non-load-bearing partition walls.

L-corner block is used in 6 or 12 inch thick walls at the corner. This gives the appearance of using full and half length units, but requires no cutting of the units at the corners.

Control joint blocks are available in a number of types and are used to construct vertical shear-type control joints.

Sill blocks are solid concrete masonry units used for sills of openings.

Solid top blocks are concrete masonry units which have a solid top for use as a bearing surface.

GROUT

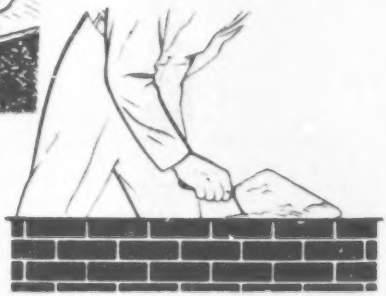
In masonry construction, grout is basically a thin form of mortar. It is made to a consistency that will flow or pour easily, but

without separation of the ingredients. Grout is used to fill cores in hollow block, and the empty space between tiers in masonry walls.

MIXING AND SPREADING MORTAR

The first task on any job is mixing the mortar. Mortar is used to bond brick and correct irregularities in the dimensions and shape of the brick. It is composed of cement, lime and sand, in proportions varying according to the use of the mortar. The dry ingredients are mixed first. Then water is slowly added while the mortar is stirred with a hoe. The water should be clean enough to drink. Any impurities, such as rust or decomposed vegetation, might interfere with the adhesive qualities of the mortar. If too much water is added, the mixture becomes lean (thin and watery) and is difficult to spread. This is corrected by adding more cement and sand. A mortar which has too little water will be sticky and hard to work. This "fat" mortar can be improved by mixing in more water. When preparing mortar, mix only as much as will be used in 1-1/2 to 2 hours.

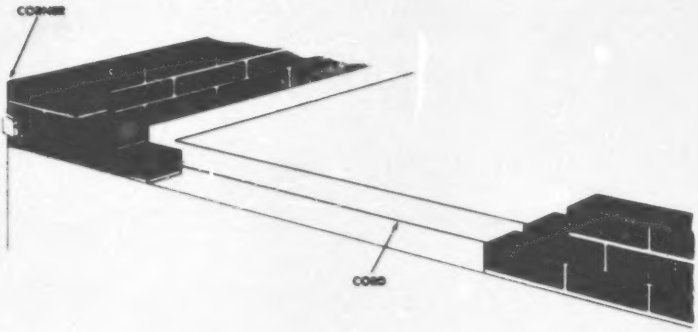
Spreading mortar is fairly difficult for most beginners, but can be mastered with practice. First, a load of mortar is placed on the mortarboard. Then the bricklayer holds the trowel lightly and scoops up a trowelful of mortar. As the mortar is applied, the



trowel is tipped so that the mortar begins flowing off along the previous course. The mortar is spread evenly and beveled away from the back of the brick so that it will not drop behind the course.

LAYING BRICK TO A LINE

Laying brick to a line is the core of bricklaying. Any bricklaying task, no matter how complex, is merely a variation of this process. To begin, a line is stretched out along the course to insure that the brick is laid in a straight, even line. On a long course, the line will have a tendency to sag from its own weight. This calls for a *trig* — a brick which props up the line and prevents it from blowing out of alignment.



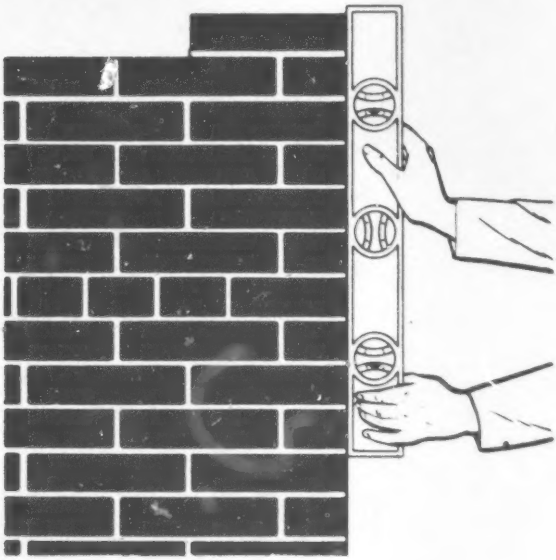
When laying the course, each brick should be laid so its top edge is even with the bottom of the line. The edge of the brick should be about as far away from the line as the line is thick. When brick is laid so that it touches the line, the result is known as *crowding*.

In laying brick, a layer or *bed* of mortar is spread first. Then a layer of mortar is "buttered" to either one end of the brick to be laid or to the end of the last brick laid. In a single motion, the brick is placed on the bed while positioning the mortar joint between the bricks to the desired width. A tap or two with a trowel positions the brick to the course line. The bricklayer cuts off the excess mortar with a trowel and is then ready to lay the next brick. Once the course is completed, or sometimes sooner, the mortar joints between the brick are struck (*jointed*) with special finishing tools to achieve a neat and uniform appearance.

As each course of brick is laid, the bricklayer must check the work to make sure that it is level (plumb). The tool used to check this is called a spirit level or a *plumb rule*. It is a light wood frame containing a series of small glass tubes of alcohol with an air bubble enclosed. An object is level when the air bubble in the spirit level centers in the tube. Each course of brick should be checked for accuracy both in parallel and right angles to the direction of the

work. Any brick work should be done with these four rules in mind:

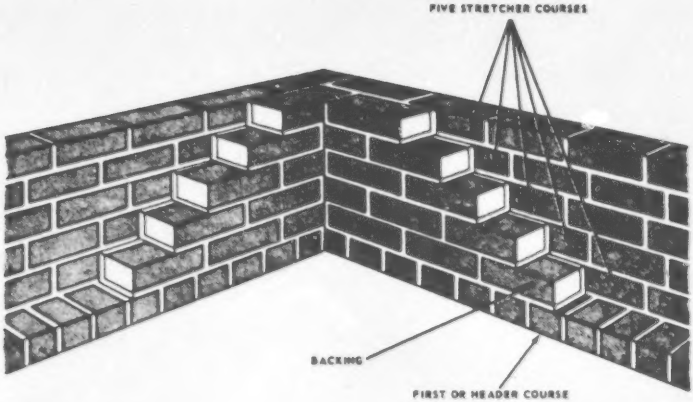
1. Keep the work on height.
2. Keep the work level.
3. Plumb the work.
4. Straightedge the work.



With these processes in mind, a person should be ready to construct some of the basic structures which bricklayers are called upon to build. These include inside and outside corners and four, six and eight brick piers.

CORNERS

To lay the corner for a 4 inch wall, a guideline is marked out using a pencil and a steel square. The first course is laid out dry and only the corner brick is laid in mortar. Then a brick is laid about three feet from the corner, level and straight with the corner brick. A brick on the other side of the corner is laid in the same way. Then the remaining bricks are filled in and the following courses are built up. As they are built up they must be kept on height, level, plumb and straight. As each course is laid, the corner of one course should overlap the corner of the course previously laid.



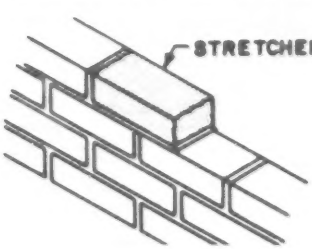
PIERS

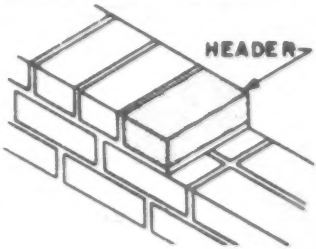
A slightly more complex project is laying out a six brick pier. This type of brick construction is often used to support beams. The first course is composed of two L's. Two bricks laid end-to-end form the long side of one L. The short side of the L is one brick laid with its end against the edge of the long side. The second L forms a rectangle with the first. Then the bricklayer spreads the mortar and butters and lays the brick. The bricklayer must stagger the joints of alternating courses, keeping the work on height, level and plumb.

An eight brick pier is similar to the six brick pier and can be used to support beams and other loads. The difference between the six brick and eight brick pier is that each side has two bricks facing outward, so that the eight brick pier is square shaped.

BONDS

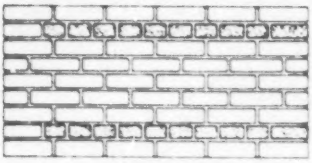
When a wall is built up of two withes of masonry, the withes must be bonded together to make one unit. This structural bond may be created by pouring grout between the withes, embedding metal ties on the joints or by interlocking the brick between the



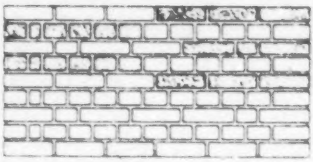


withes. When the interlocking method is used, the bricks that are laid along the length of the withe are called *stretchers;* the bricks laid across both withes are called *headers*.

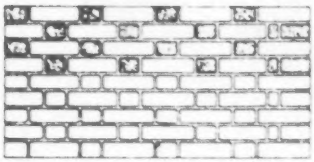
American (common) bond is laid out by having five, six or seven stretcher courses followed by a header course. English bond uses a stretcher course followed by a header course in alternating sequence. Flemish bond has alternating stretchers and headers in each course. Dutch bond is a variation on the English bond with vertical joints between stretchers in alternate courses not aligned.



COMMON



ENGLISH



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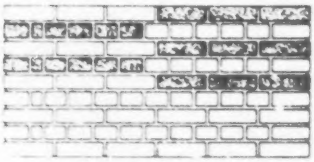
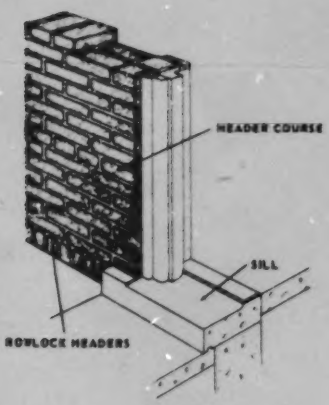


DUTCH

DOORS AND WINDOWS

Bricklayers will often need to do brickwork around doors and windows. Brick window sills generally use a course of brick laid on edge with their ends exposed and laid on top of a course of bricks. The bricklayer must first calculate the layout of the sill with a spacing rule. Then a bed of mortar is troweled onto the top layer of bricks. This mortar bed should be beveled down at the angle at which the sill will face outward. Once the mortar bed has been prepared, bricks should be laid on edge starting at the right and left edges and going toward the center. The center brick (closer) should be buttered on both sides as should the bricks on either side. When laying brick in and around openings, such as doors and windows, it's often necessary to cut it into 1/2 and 1/4 size lengths. Brick is generally cut with a brick chisel, which has wide edges and a beveled edge at the bottom. When brick is cut, the beveled edge of the chisel should be turned toward the bricklayer and the piece of brick to be cut and then used should be away.



Sometimes it will be difficult to get an even number of bricks into an opening. In order to make a fit, it may be necessary to stretch or compress brickwork by making joints between bricks thicker or thinner.

FIREPLACES

Fireplaces vary widely in the details of their construction. This means that the first step in building a fireplace is to select the plans. Following the plans, the bricklayer lays out the bottom and sides of the ash pit and brings up the walls. The bricklayer builds any templates and other items that are needed. The hearth bed is poured, and the firebox built. Last, the outer brickwork and the chimney are built.

PATIOS

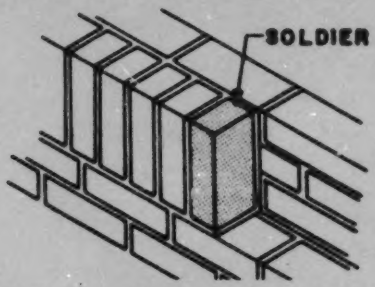
Patio brick is laid in two common patterns, either herringbone or basket weave. Herringbone patterns are formed by placing bricks at right angles to one another. Basket weave patterns are formed by building a series of squares which are composed of two or three bricks placed side by side.

Brick patios are usually laid over packed sand. The sand should be smooth and level. The patio may be mortared in the usual manner or by filling the cracks between the bricks with dry mortar. Then the patio is wetted down, joining the bricks together.

ARCHES

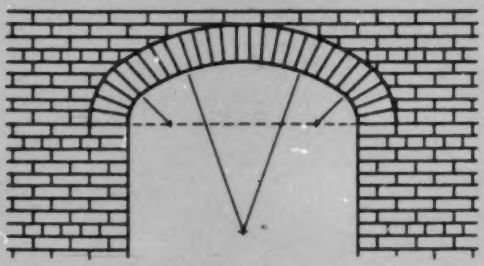
Although there are many different arches, there are several features which all of them have in common. Arches are overhead brickwork placed over doors and windows. When arches are built,

temporary shoring or scaffolding is placed to hold up the weight of the masonry. The arch should cure for ten days before the support is removed. Bricks in arches are usually joined in *soldier*

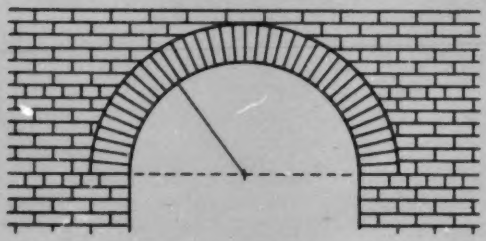


courses. A soldier course is one in which brick is laid on edge and joined together along the adjoining faces. When building arches, it is especially important to fill all the mortar joints completely.

There are two major methods used in constructing arches. In one method, mortar joints of uniform thickness and specially cut pieces of brick are used. In the other, standard bricks and mortar joints of different thicknesses are used. No matter which method is used, the mortar must be of high quality and durable because it must support a heavy weight for a long time.



ELLIPTICAL ARCH



CIRCULAR ARCH

Employment of brickmasons and brick and block layers is expected to increase. The demand for bricklayers will be favorably affected by the increasing use of structural clay tile for fire-resistant partitions and the use of ornamental brickwork for structures, such as exterior screenwalls, lobbies and foyers. The use of brick load-bearing walls in construction is growing.

These favorable developments will be offset, to some extent, by other construction techniques that reduce the amount of brickwork per structure and increase the efficiency of bricklayers. For example, the rapidly expanding use of thin masonry load-bearing walls is eliminating steel and reinforced concrete framework. Also, the use of metal, glass and precast concrete wall panels results in less masonry work.

Recent developments that have increased the efficiency of bricklayers, include high-strength mortars that can be applied with caulking guns or compressor-powered extruders.

CONCRETE MASONRY

Concrete masons pour and finish concrete for projects that range from patios and sidewalks to huge dams, massive building foundations and airport runways. On small projects, assisted by one or two helpers, the concrete mason may do all the concrete work. On large projects a crew of several concrete masons and many helpers may be employed. Regardless of the size of the project, there are certain basic processes common to all concrete work. A concrete mason must be able to place forms and set reinforcing rods, estimate, mix, pour and finish concrete. Special preparations and techniques vary from structure to structure. Before considering the processes involved in concrete construction, you should become familiar with the materials used.

MASONRY MATERIALS

Concrete is a synthetic construction material made by mixing cement, fine aggregate (usually sand), coarse aggregate (usually gravel or crushed stone) and water in proper proportions. The product is not concrete unless all four of these ingredients are present. A mixture of cement, sand and water, without course aggregate, is not concrete but mortar or grout. A concrete wall or floor must include aggregate, in addition to the other three ingredients.

The fine and coarse aggregate in a concrete mix are called the "inert" ingredients, the cement and water are the "active" ingredients. The inert ingredients and the cement are thoroughly mixed together first. As soon as the water is added, a chemical reaction between the water and the cement begins. It is this reaction, called hydration, that causes the concrete to harden.

It is important to remember that the hardening process is caused by hydration of the cement by the water, not by a drying out of the mix. Instead of being dried out, the concrete must be kept as moist as possible during the initial hydration process. Drying out would cause a drop in water content below the amount required for satisfactory hydration of the cement.

Since the hardening process has nothing to do with drying out of the concrete, it will harden just as well *under* water as it will above water.

CEMENT

Most cement used today is Portland cement, which is usually manufactured from limestone mixed with shale, clay or marl. There are five common types of Portland cement in use today.

The type of construction, chemical type of the soil and the requirements for use of the finished concrete, are factors which influence the selection of the type of cement to be used.

Type I (normal Portland cement) is used for all general types of construction. It is used in pavement and sidewalk construction, reinforced concrete buildings and bridges, railways, tanks, reservoirs, sewers, culverts, water pipes, masonry units and soil-cement mixtures. In general, it is used when concrete is not subject to special sulfate hazards or where the heat generated by the hydration of the cement will not cause an objectionable rise in temperature.

Type II (modified Portland cement) has a lower heat of hydration than type I, and improved resistance to sulfate attack. It is intended for use in structures of considerable size, where cement of moderate heat of hydration will tend to minimize temperature rise, as in large piers, heavy abutments, heavy retaining walls and when the concrete is placed in warm weather. In cold weather, when the heat generated is helpful, type I cement may be preferable for these uses. Type II cement is also intended for places where an added precaution against sulfate attack is important, as in drainage structures where the sulfate concentrations are higher than normal.

Type III (high-early-strength Portland cement) is used where high strengths are desired at very early periods. It is used where it is desired to remove forms as soon as possible, to put the concrete in service as quickly as possible, and in cold weather construction to reduce the period of protection needed against low temperatures. High strengths, at early periods, can be obtained more satisfactorily and more economically using high-early-strength cement than using richer mixes of type I cement. Type III develops strength at a much faster rate than other types of cement.

Type IV (low-heat Portland cement) is a special cement for use where the amount and rate of heat generated must be kept to a minimum. This type of cement was first developed for use in the Hoover Dam. It develops strength at a slow rate and should be cured and protected from freezing for at least 21 days. For this reason it is unsuitable for structures of ordinary dimensions and is available only on special order from a manufacturer.

Type V (sulfate-resistant Portland cement) is a cement intended for use only in structures exposed to soils or groundwater with a high sulfate content. It has a slower rate of hardening than normal Portland cement. The sulfates react chemically with the hydrated lime and the hydrated calcium aluminate in the cement paste. This

reaction results in considerable expansion and disruption of the paste. Cements which have a low content of calcium aluminate have a great resistance to sulfate attack. Type V Portland cement is used exclusively for situations involving severe sulfate concentrations.

Air-entrained Portland cement is a special cement that can be used with good results for a variety of conditions. It has been developed to produce concrete that has a resistance to freeze-thaw action and scaling caused by chemicals applied for severe frost and ice removal. In this cement, very small quantities of air-entraining materials are added as the clinker is being ground during manufacturing. Concrete made with this cement contains minute, well-distributed and completely separated air bubbles. The bubbles are so minute that it is estimated there are several million of them in a cubic foot of concrete. Air bubbles provide space for water to expand, due to freezing, without danger to the concrete. Air-entrained concrete has been used in pavements in the northern States for over 25 years with excellent results. The Agent may be added to types I, II and III Portland cement. An advantage of using air-entrained cement is that it can be used and batched like normal cement.

AGGREGATE

The material which is combined with cement and water to make concrete is called *aggregate*. Aggregate helps to increase the strength of concrete while reducing the shrinking tendencies resulting from loss of moisture. Not only does aggregate aid in the strength of concrete, but it is also used as a filler for economical purposes. The aggregate is divided into *fine* (usually sand) and *coarse*. For most ordinary building concrete, the coarse aggregate usually consists of gravel or crushed stone, running not more than about 1½ inches in size. In massive structures like dams,

however, the coarse aggregate may include natural stones or rocks ranging up to 6 inches or more in size.

Here are the fundamental structural mechanics of a concrete mix. The large, solid coarse aggregate particles form the basic structural members of the concrete. The voids between the larger coarse aggregate particles are filled by smaller particles, until finally the voids between the smallest coarse aggregate particles are filled by the largest fine aggregate particles. The voids between the largest fine aggregate particles are filled by smaller fine aggregate particles, and so on. The better the aggregate is "graded" (distribution of particle sizes), the more solidly all voids will be filled, making more dense and stronger concrete.

The cement and water form a paste which binds the aggregate particles solidly together when it hardens. In a well-graded, well-designed and well-mixed batch, each aggregate particle is thoroughly coated with cement water paste so that each particle is solidly bound to adjacent particles when the cement-water paste hardens.

The existing gradation, or distribution of particle sizes from coarse to fine in a supply of fine or coarse aggregate, is determined by extracting a representative sample of the material, screening the sample through a series of sieves and determining the percentage of the total sample which is retained. This procedure is called making a *sieve analysis.*

Since from 66 to 78 percent of the volume of the finished concrete consists of aggregate, the aggregate must measure up to certain minimum quality standards. It should have clean, hard, strong, durable particles which are free of any chemicals which might interfere with hydration, and of any superfine material which might prevent bond between the aggregate and the cement-water paste. The undesirable substances most frequently found in aggregate are dirt, silt, clay, coal, mica, salts and organic matter. Most of these can be removed by washing.

Weak, friable (easily pulverized), or laminated (containing layers) aggregate particles are undesirable. Shale, stones laminated with shale, and most varieties of chert (impure flintlike rock) should be avoided. For most ordinary concrete work, visual inspection is enough to reveal any weaknesses in the coarse aggregate. For work in which aggregate strength and durability is of vital importance (paving concrete), aggregate must be laboratory-tested.

WATER

The principal function of the water in a concrete mix is to bring about the hardening of the concrete through hydration of the

cement. Another essential function is to make the mix workable enough to satisfy the requirements of the job at hand. To attain this result, a mix which is to be poured in forms must contain additional water over and above the amount required for complete hydration of the cement. Too much water will cause a loss of strength by upsetting the water-cement ratio. It will also cause "water gain" on the surface, a condition which leaves a surface layer of weak material called *laitance*. An excess of water will impair the watertightness of the concrete.

Mixing water should be free of any acids, alkalis or oils which would interfere with the hydration process. Water containing decayed vegetable matter is especially to be avoided. Most specifications require that the mixing water be fit for drinking, since any water fit for drinking is usually satisfactory for concrete.

The specified ingredient proportions are those which will produce an economical concrete of the strength and durability required for the project. Durability is to a large extent controlled by strength. This means that the stronger the concrete, the more durable it will be. The quality of the aggregate, the aggregate grading and the proportion of fine to coarse also have an important effect on durability.

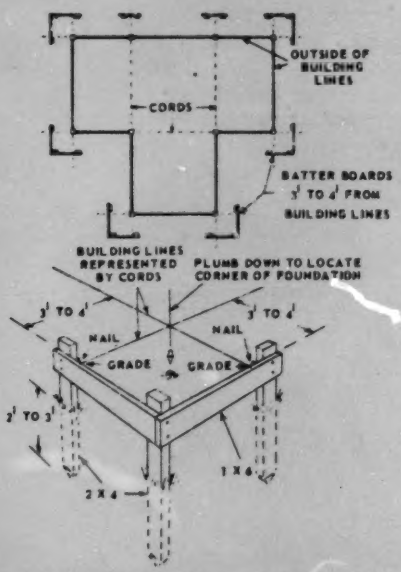
Another major factor controlling strength, everything else being equal, is the amount of water used per bag of cement. Maximum strength would be obtained by using just the amount of water that is required for the complete hydration of the cement.

As previously mentioned, a mix of this type would be too dry to be workable. Therefore, a plastic concrete mix always contains more water than the amount required to attain maximum strength. The point to remember is that the strength of the concrete decreases as the amount of extra water increases.

The specified water-cement ratio is the happy medium between the maximum possible strength of the concrete and the necessary minimum requirement for workability. The strength of building concrete is expressed in terms of the compressive strength in pounds per square inch (psi) reached after a 7-day set and/or after a 28-day set. This is usually referred to as "probable average 7-day strength" and "probable average 28-day strength."

BATTER BOARDS

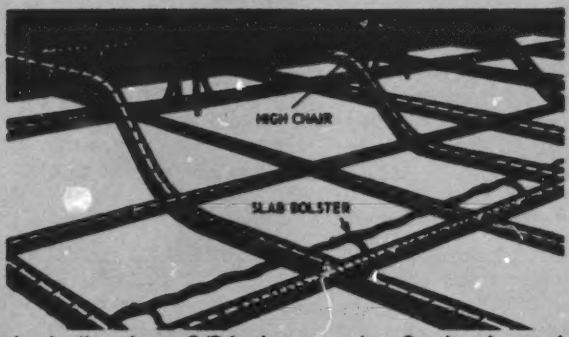
Before any construction can begin on the job site, the concrete mason must mark off the outline of the building with batter boards — 2 x 4's driven vertically into the ground with horizontal members made up of 1 x 6 pine stock forming a 90° outside corner.



These markers must be placed far enough outside the building lines so they will not be disturbed during excavations. Care should be taken that the batter boards are set parallel to the building lines and at the desired elevation of the forms. String is stretched between the cross boards corresponding to the lines of the building. The lines are plumbed at the point they intersect to make certain they are true.

REINFORCING BAR

Each structure requires a different net of steel reinforcing bar (rebar). The slab is the most basic example. If it is less than 14



feet in both directions, 3/8 inch or number 3 rebar is used. If the slab is greater than 14 feet in both directions, 1/2 inch or number 4 rebar is used. The plans for the structure will show how far apart the rebar is placed. Often, rods will be placed 9 inches apart from center to center, and then a second layer of rods at right angles to the first will be laid over them, 12 inches apart from center to center. At each point where two rods cross each other, they are tied together with wire.

Beneath the rod net, a brick or concrete block support is placed approximately every 6 feet. Wire supports (chairs) are also often

used to support the rods. Low chairs are used for one level of rods, and high chairs for two or more levels. Before the slab is poured, plumbers must lay the basic plumbing lines.

Rebar is also placed in beams. Beam steel should be wired together outside the form, usually four bars to a beam. The bars are held together by four 90° angle steel rods wired to the bars at the top and bottom. About every 18 inches, an X-shaped heavy wire supporting pattern (stirrup) is wired onto the steel bars.

After the forms for the concrete have been placed and reinforcing bar has been set, pouring may begin.

MIXING CONCRETE

Although concrete is most often premixed and brought to the job site in trucks, a concrete mason should be capable of doing his own mixing. Concrete sets, hardens and acquires its strength from a chemical reaction with water called hydration. Too much water will reduce strength, while too little water will make the concrete stiff and difficult to work.

The strength and properties of concrete needed will vary on the requirements of the structure being built. For residential foundation slabs, the mixture will often be 225 pounds of sand to 390 pounds of gravel to 94 pounds of cement, adding 6 gallons of water. The mixture will yield 4.66 cubic feet. (Concrete is measured in cubic yards with 27 cubic feet to 1 cubic yard.)

The dry ingredients of concrete are mixed first by hand. Coarse particles should not be more than 3/4 inch as wide as the narrowest space through which the concrete will pass. This is usually the space between the reinforcing bars. The amount of water added to a mixture varies from 4 to 9 gallons per sack, with each sack of cement weighing 94 pounds.

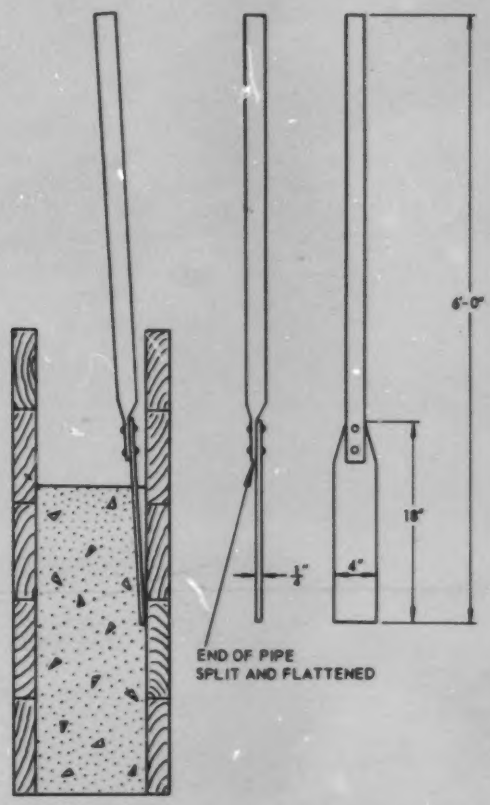
PLACING CONCRETE

Before placing concrete, the forms are sprayed with water to dampen them. Then the concrete is placed in the corners of the form. This is done either from the discharge chute of the concrete truck or from wheel barrows. Concrete must be placed in smooth, even layers, or the coarse aggregate will separate out, leaving a weak, crumbly concrete. The concrete is worked with a shovel into the spaces between and under the reinforcing bars. Each new load of concrete should be placed on the face of the previous load, making sure that the coarse aggregate does not separate out.

Concrete should not be dumped with a free fall more than 3 feet. If a drop of more than 3 feet occurs, the concrete is funneled

down a chute. Once the load of concrete has been placed, and worked into the spaces between and under the reinforcing rod, it is tamped or vibrated. This compacts and strengthens, (consolidates) the concrete.

If concrete were simply dumped into forms and left to harden, it would have several defects. A large number of air pockets trapped in the finished product would produce a honeycomb effect. Large areas of coarse aggregate would be exposed. Narrow spaces in the forms and between the reinforcing bars would be left unfilled. To avoid these problems, cement masons consolidate the concrete, using either spades or mechanical vibrators. The spade is shoved down along the inside surface of the form and well into the concrete. Then the spade handle is worked back and forth until the air pockets have been worked out and all the spaces in the forms have been filled.



Mechanical vibrators can be used to work very stiff concrete. Two types are commonly used. Internal vibrators place a vibrating element into the concrete itself. It is inserted into the concrete at 18 inch intervals for 5 to 15 seconds at a time. The concrete has been vibrated enough when a thin line of mortar appears along the form near the vibrator and the coarse aggregate has sunk below the surface. External vibrators are attached to the forms.

If concrete can be consolidated by hand spading, it should not be vibrated. When a vibrator is used, there should also be a person spading it. Vibrators should not be used to move concrete over long distances.

Once the concrete has been consolidated it is *screeded* to remove excess concrete and level the slab. The concrete is removed by a straightedge board which rides along the edges of the forms or along wood or metal strips. Two people do the screeding, moving the straightedge back and forth in a sawing motion as they push it down the slab.

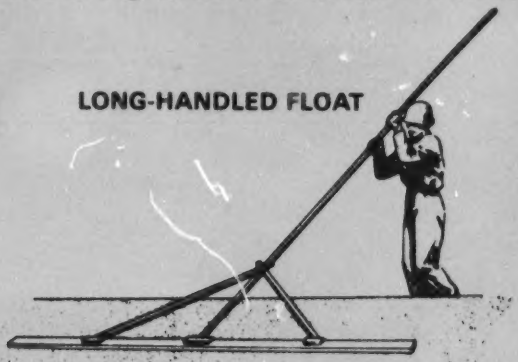
On larger slabs, such as those used on highways and bridge decks, mechanical vibrating screeds are often used. Vibrating screeds can be used with much stiffer concrete and operate much faster than hand operated screeds. A vibrating screed usually consists of a beam, with a gasoline engine mounted in the center. Two people pull it along, one at each end. Concrete is usually kept in place 15 to 20 feet ahead of the screed. Sometimes hollow spots will appear in the concrete. Where this happens, a shovel full of concrete is spaded onto the concrete and the screed is run over it again.

FINISHING CONCRETE

After screeding is complete, the concrete is ready to be finished. Several steps are involved in the finishing process. First, the concrete is *darbied*. This smooths out the rough spots left after the concrete is screeded. The edging process finishes the part of the slab next to the forms. Trowels, (edgers) are run around the outer edge of the slab to submerge whatever coarse aggregate particles are exposed. This leaves a finished surface.

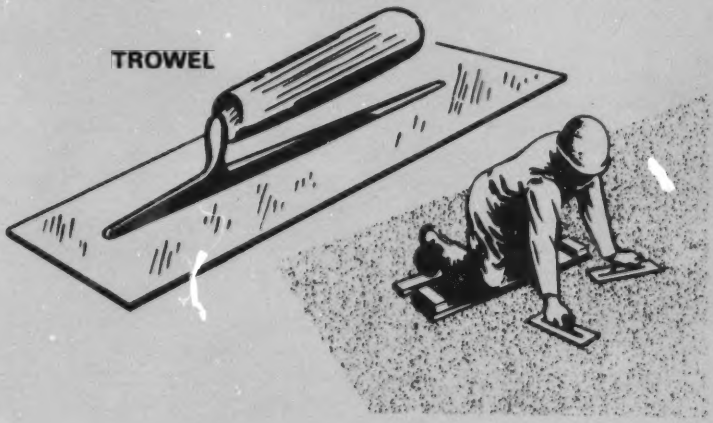
In order to prevent cracks which might occur due to rapid temperature changes during drying, joints must be cut in the slab early in the curing period. Using a straightedge board as a guide, the mason makes the cut with a hand-held jointing tool. A power saw equipped with a diamond-toothed blade is used after the concrete has been placed 4 to 12 hours. Joints are generally spaced 6 feet apart on sidewalks and 15 to 20 feet apart on driveways.

Floating comes next. An aluminum or magnesium float is used on small slabs, and long-handled wooden floats on larger jobs. The float is moved in long, smooth, even strokes over the surface of



the concrete. Floating, (a) embeds large aggregate just below the surface and brings the fine aggregate to the top, (b) smooths out whatever bumps and dips are left after the darbying process, and (c) prepares the surface mortar for the rest of the finishing operation.

A smooth even surface is then provided by *troweling* the concrete with a steel trowel. The trowel is held flat against the surface of the concrete and moved back and forth with long smooth, even strokes. If the trowel is held at an angle, a rough, uneven surface will result. The surface can be made smoother and smoother by additional trowelings, but concrete should not be overworked. Overworking tends to bring too much fine aggregate to the surface, which will leave it thin and weak.



After the surface has been steel troweled, it becomes very smooth and slippery. To keep these surfaces from being dangerous to walk on when wet, they are broomed before final setting. The mason pulls a broom over the setting concrete. This will roughen the surface slightly and will leave a finish which is not slippery when wet. Another way to avoid a slippery surface, is to trowel a second time with a light, circular motion.

CURING CONCRETE

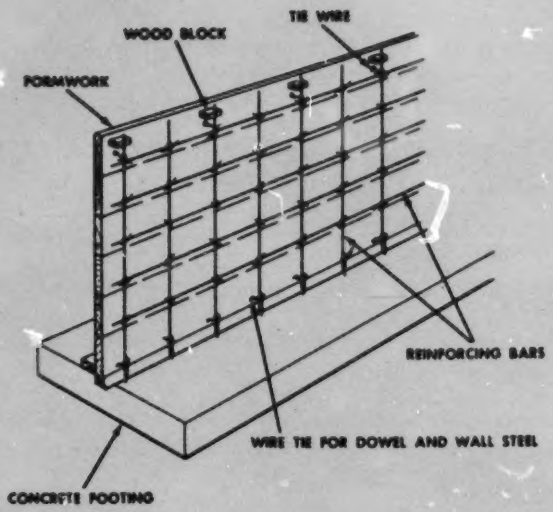
Curing is the process which allows the cement-water mixture to reach a maximum degree of hardness. Sometimes a fine mist of water is sprayed onto the concrete. On flat slabs, water is left to stand for several days (ponded). The surface which results from ponding is smoother than the one from misting. Frequently, newly set concrete will be covered with some kind of moisture-proof covering, such as sheets of burlap or polyethylene. This covering is left on for 3 to 7 days.

Concrete should not be poured or worked at temperatures below 40°F without being preheated to a temperature between 50° and 70°F. A temperature of 50°F should be held for 5 days after the concrete is poured; 70° should be held for 3 days. In order to keep this temperature, a tarpaulin cover or a covering of several inches of straw may be needed. On the other hand, in hot weather the concrete may be mixed with ice water. Damp tarpaulins or damp burlap may be placed over it, after it is screeded, to keep it from drying out completely. It should be worked as quickly as possible and then re-covered with a damp burlap.

PLACING CONCRETE WALLS

Procedure for placing concrete walls is essentially the same as for slabs. One basic difference is that prefabricated wood and steel forms are reusable. Because appearance is important, wooden forms should be treated with shellac to mask the wood grain pattern.

As with slabs, the mason begins in the corners and then works back toward the center of the form. If concrete is dropped more than three feet without a chute, it will place excessive strain on the forms, in addition to the problems mentioned earlier. Gradually, several layers of concrete 6 to 24 inches thick are placed, one layer on top of another. As the concrete is placed, it is worked with a spade in between reinforcing rods, plumbing, conduit lines and the like. Concrete should not be placed faster than it can be worked into these hard-to-get-spaces.



Consolidation of concrete walls, like slabs, is done with vibrators. Vibrators may either be placed inside the placed concrete itself, or attached to the outside of the form. The vibrator should be left operating only until exposed coarse aggregate sinks. If the concrete is vibrated too much, the coarse and fine aggregates will tend to separate out and leave a weak concrete.

After the coarse aggregate has sunk, the excess concrete remaining on top is screeded off. This is done with a straight board moved back and forth in a sawing motion. A wide wall surface can be troweled with power trowels. Smaller surfaces are hand troweled, and hard to get at places close to edges or close to obstacles are also hand troweled. A smooth, but non-slippery surface can be obtained by troweling in a circular motion a second time. The finished surface should be smooth and even, free from ripples and rough edges. Curing procedures are then applied to slow down the evaporation of water and the surface should be covered with damp burlap. The forms are removed once the concrete in a wall has set. The braces are knocked away and the stakes are pulled up. Then the walers, studs, plates and facing materials are pulled away. Defects in the surface are patched by troweling in a grout mixture of two parts sand to one part Portland cement. Water is added until it has a creamy consistency.

There are several final treatments a concrete surface may receive. If the surface will be in contact with moisture, a fine layer of as-

phalt may be brushed or sprayed onto the surface. If the surface will be exposed, it may be given either a stoned finish or a sack-rubbed finish. A stoned finish is obtained by coating the concrete surface with a grout mix. Then the surface is ground with a flat stone. A sack-rubbed finish can be obtained by applying grout to the surface with burlap or a sponge float, then dry sand and cement are rubbed into the moist grout.

PLASTERING

Plasterers are building people who apply a plaster coating to interior walls and ceilings to form fire-resistant and relatively sound-proof surfaces, which may later be painted or covered with wall paper. They also apply more durable cement plaster or stucco to exterior walls. They can form or cast ornamental designs in plaster, such as cornices and paneling, or form recesses for indirect lighting.

PLASTERING MATERIALS

Plaster and stucco, like concrete, are construction materials which are applied in a plastic condition and harden in place after being applied. The fundamental difference between plaster and stucco is simply one of location. If the material is used internally, it is called plaster; if it is used outdoors, it is called stucco.

Again, like concrete, the active ingredients in plaster is a cementitious material (binder). If plaster is applied in more than one layer, the top layer is called the *finish coat* and each of the lower layers is a *base coat.* Plaster for a finish coat may consist of binder alone, but, most finish coat plaster and most base coat plaster contains aggregate, as well as binder. Plaster aggregate may consist of sand, or one of several other materials. The aggregate in plaster, like the aggregate in concrete, provides additional bulk and stability.

The principal difference between plaster and concrete is that concrete can, because of its high compressive strength, be used as a load-bearing structural material. The considerably lower strength of plaster has, up until now, confined its use principally to finish. Experiments are now being conducted to develop plasters with load-bearing strength.

A plaster mix, like concrete mix, is made plastic for application by the addition of water to the dry ingredients. Like concrete, it is a reaction of the binder to the water, called hydration, that causes the mix to harden.

The binders most commonly used for plaster are gypsum, lime, and Portland cement. Because gypsum plaster should not be exposed to free water or severe moisture conditions, it is usually confined to interior use. Lime and Portland cement plaster may be used both internally and externally.

GYPSUM PLASTER

Gypsum is a naturally occurring sedimentary gray, white or pink rock. The natural rock is crushed and then heated to high temper-

atures, a process (calcining) which drives off about three-quarters of the water of crystallization which forms about 20 percent by weight of the rock in a natural state. The calcined material is then ground to a fine powder and certain additives are mixed to control set, stabilization and other physical or chemical characteristics.

For a type of gypsum plaster called Keene's cement, the crushed gypsum rock is heated until nearly all of the water of crystallization is driven off. To offset slow-setting caused by absence of so much water of hydration, an Englishman named Keene patented a process of adding alum as an accelerator. The resulting plaster, called Keene's cement, produces a very hard, fine-textured finish coat.

The removal of water of crystallization from natural gypsum is a dehydration process. In the course of setting, mixing water (water of hydration) added to the mix rehydrates with the gypsum, thus causing recrystallization. Recrystallization causes the plaster to harden.

There are four common types of gypsum basecoat plasters:

- *Gypsum neat* plaster is gypsum plaster without aggregate, intended for mixing with aggregate on the job.
- *Gypsum ready-mixed* plaster consists of gypsum and ordinary mineral aggregate and requires addition of only the water at the job site.
- *Gypsum wood-fibered* plaster consists of calcined gypsum combined with not less than 0.75 percent by weight of non-staining wood fibers. It may be used as is or mixed with one part sand to produce base coats of superior strength and hardness.
- *Gypsum bond* plaster is designed to bond properly prepared monolithic concrete. It consists essentially of calcined gypsum mixed with from 2 to 5 percent lime by weight.

There are five common types of gypsum finish coat plasters:

- *Ready-mix gypsum finish* plasters are designed for use over gypsum plaster base-coats. They consist of finely ground calcined gypsum, some with and others without aggregates. At the job they require addition of water only.
- *Gypsum acoustical* plasters are designed to reduce sound reverberation.
- *Gypsum gauging* plasters contain lime putty, which provides certain setting properties, increases dimensional stability during drying, and provides initial surface hardness. Gauging plasters are obtainable as slow-set, quick-set and special high strength.

- *Gypsum molding* plaster is used primarily in casting and ornamental plaster work. It is available neat (without admixtures) or with lime. As with Portland cement mortar, the addition of lime to a plaster mix makes the mix more "buttery."
- *Keene's cement* is a fine, high density plaster capable of creating a highly polished surface. It is customarily used with lime putty and with fine sand which provides crack-resistance.

LIME PLASTER

Lime is obtained principally from the calcining of limestone, a very common mineral. During the calcining process, certain chemical changes occur which transform the limestone into *quicklime*. Quicklime which meets certain requirements is pulverized for building use. Other quicklime is further processed into hydrated lime for building use.

Before being used for plastering, quicklime must be *slaked*. Slaking is adding the quicklime to water. A chemical change will occur when adding quicklime to water. Always add quick-slaking lime to water and when escaping steam appears, the lime should be hoed and just enough lime added to stop the steaming. When mixing medium-slaking and slow-slaking limes, the water should be added to the lime. The slow-slaking lime must be mixed under an ideal temperature, making it necessary to heat the water in cold weather. Magnesium lime is easily "drowned" by too much water being added to the lime. When too little water is added to either calcium or magnesium limes, they are "burned." Whenever lime is burned or drowned, a part of it is spoiled and it will not harden. The paste then, is not as sticky and plastic as required. The quicklime must be soaked for an extended period of as much as 21 days. The end-product is plastic lime putty.

Because of the delays involved in the slaking process, most building lime is hydrated lime. Normal hydrated lime is converted into lime putty by soaking for at least 16 hours. Special hydrated lime develops immediate plasticity when mixed with water and may be used right after mixing. Like calcined gypsum, lime plaster tends to return to its original rock-like state after application.

For interior basecoat work, lime plaster has been largely replaced by gypsum plaster. It is now used principally for interior finish coats. Because lime putty is the most plastic and workable of the cementitious materials used in plaster, it is often added to other less workable plaster materials to improve plasticity. For lime plaster, lime in the form of either dry hydrate or lime putty is mixed with sand, water and a gauging material. A gauging material is intended to produce early strength and to counteract shrinkage tendencies. The gauging material may be either gypsum gauging plaster or Keene's cement for interior work, or Portland cement for exterior work.

PORTLAND CEMENT

Portland cement plaster is similar to the Portland cement mortar used in masonry. It may contain cement, sand and water only, but lime ground asbestos or some other plasticizing material is usually added for "butteriness."

Portland cement plaster may be applied directly to exterior and interior masonry walls, or over metal lath. Portland cement plaster is never applied over gypsum plasterboard or over gypsum tile. It is recommended for use in plastering walls and ceilings of large walk-in refrigerators and cold storage spaces, basement spaces, showers and similar areas where an extra hard or highly water resistant surface is required.

AGGREGATE

The aggregates most commonly used in plaster are sand, vermiculite and perlite. Generally speaking, any sand retained on the No. 4 sieve is too coarse to use in plaster, and only a small percentage of the material (about 5 percent) should pass the No. 200 sieve.

Sand for plaster, like sand for concrete, must be free of more than a specified minimum of organic impurities and harmful chemicals. Proper aggregate gradation influences plaster strength and workability and likewise has an effect on the tendency of the material to shrink or expand while setting.

Plaster strength is reduced if excessive fine aggregate material is present in a mix. The greater quantity of mixing water required

raises the water-cement ratio, reducing the dry set density. The cementitious material becomes overextended because it must coat a relatively larger overall aggregate surface. Too much coarse aggregate affects workability because the mix becomes "harsh working" and difficult to apply.

Plaster shrinkage during drying may be caused by too much fine or coarse aggregate. Because an excess of fine increases the aggregate total surface area, a larger quantity of binder paste is needed to coat all particles. The mix becomes too rich in cement material, and it is the cement material which is unstable after application. The end-effect is much the same if there is too much coarse. If there is not enough fine to fill the voids between coarse particles, more cement material must be used to fill these voids. Again the result is a rich and relatively unstable material.

Vermiculite is a micaceous mineral—meaning a mineral in which each particle is laminated or made up of adjoining layers. When vermiculite particles are exposed to intense heat, steam forms between the layers forcing them apart. This causes each particle to increase from 6 to 20 times in volume. The expanded material is soft and pliable, with a color varying between silver and gold.

For ordinary plaster work, vermiculite is used only with gypsum plaster for interior coatings. For acoustical plaster, vermiculite is combined with a special acoustical binder.

Expanded vermiculite is manufactured in five types (I, II, III, IV and V) according to particle size. Only type III is used in plastering. It is the lightest of the standard plaster aggregates, weighing only from 6 to 10 pounds per cubic foot. The approximate dry weight of a cubic foot of 1:2 gypsum-vermiculite plaster is 50 to 55 pounds. The dry weight of a cubic foot of comparable sanded plaster is 104 to 120 pounds.

Raw perlite is a volcanic glass which, when flash-roasted, expands to form frothy particles of irregular shape that contain countless minute air cells. Perlite ore is crushed and then heated to a high temperature. As the particles soften, combined water turns to steam, causing the particles to "pop" and form a frothy mass of glass bubbles 4 to 20 times the volume of the raw particle. The process is called expanding and the color of expanded perlite ranges from pearly white to grayish white.

Perlite is used with calcined gypsum or Portland cement for interior plastering, and with special binders for acoustical plaster. The approximate dry weight of a cubic foot of 1:2 gypsum-perlite plaster is 50 to 55 pounds, or about half the weight of a cubic foot of sand-plaster.

Although sand, vermiculite and perlite constitute the greatest proportion of plaster aggregate, certain other materials are used. Wood fiber may be added to neat gypsum plaster at the time of manufacture and to improve the working qualities of the gypsum. Pumice is a naturally formed volcanic glass similar to perlite, but heavier (28 to 32 pounds per cubic foot, against 7.5 to 15 pounds for perlite). The weight differential gives perlite an economic advantage and limits the use of pumice to localities near where it is produced.

WATER

The mixing water in plaster performs two functions. First, it transforms the dry ingredients into a plastic, workable mass; second, it combines mechanically and/or chemically with the binder to induce hardening. As is the case with concrete, there is a maximum quantity of water per unit of binder required for complete hydration. An excess over this amount reduces the plaster strength below the maximum attainable.

In all plaster mixing, more water is added than is necessary for complete hydration of the binder. The excess is necessary to bring the mix to workable consistency. The amount that must be added for workability depends on the character and age of the binder, the method of application, the drying conditions and the tendency of the base to absorb water. A porous masonry base will draw a good deal of water out of a plaster mix. If this reduces the water content of the mix below the maximum required for hydration, incomplete curing will result.

As a general rule, only the amount of water required to attain workability is added to a mix. The water should be clean and fresh, and it must be free of chemicals which might affect the plaster's set. Water previously used to wash plastering tools should never be used for mixing plaster. It may contain particles of set plaster which may accelerate setting. Stagnant water should be avoided because such water may contain organic material which may hold back setting and possibly cause staining.

APPLICATION OF PLASTER

In interior work, the plasterer usually applies three distinct coats of plaster to ceiling and walls: Scratch, brown and finish on wood or metal lath backing to which plaster readily sticks; the initial or scratch coat is applied directly and then scratched with a special raking tool before it sets. It is allowed to set a day or more before applying the second layer of plaster (brown coat). The finish (white coat), a smooth relatively thin covering, is applied several days later.

CHECKING AND SQUARING WALLS FOR PLASTERING

Lath is the backing to which plaster is applied. Although plasterers do not install lath, they should be able to tell whether or not it is in proper shape to be plastered. There are several different types of lathing systems commonly found and are constructed of either wood or metal. Metal lath is simply a metal screen or mesh. Wooden lath consists of thin wood strips nailed to the wall studs and spaced at least 3/8 inch apart. Gypsum wallboard is now being used as lath in most new construction. It is strong and stable, but requires gypsum plaster.

Before a plasterer applies the plaster, he must make sure that the walls are squared. This involves one of two basic methods: The right triangle method or the square method.

When the *right triangle method* is used, the plasterer chooses a wall and measures out four feet from one of the corners. From the same corner, he measures out a distance of 3 feet on the adjacent wall, at which point he scribes an arc with a 3 foot radius. Finally, he measures the distance from the 4 foot mark to the 3 foot mark. The distance should be 5 feet. If it is greater than 5 feet, a 5 foot length is measured from the end of the 4 foot line to the arc. The arc and the 5 foot line should intersect. The true line of the room is found by drawing a line from the corner to the point of intersection. The process is repeated in the remaining corners.

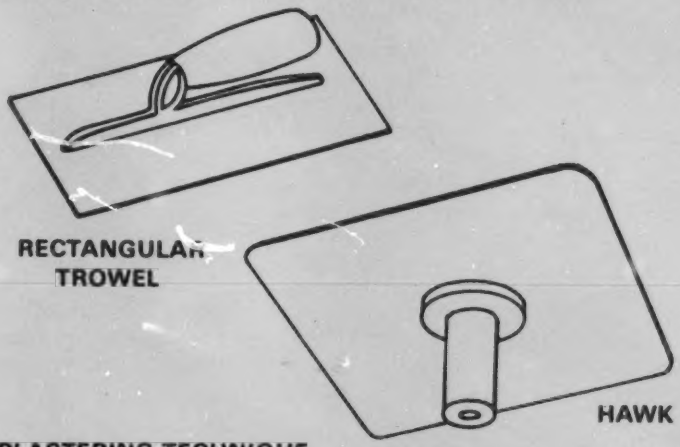
When using the *square method*, the plasterer takes an 8 or 10 foot straightedge board and places it in the starting corner against one wall. Then a 6 x 6 foot wooden square is placed in the corner, butted against the straightedge. The adjacent side of the square should run smoothly along the wall. If it does not, mark the floor with a chalkline where the line of squaring should be.

MIXING PLASTER

There are a wide variety of plasters, each of which is mixed and used in a slightly different way. Plasters are mixed with specific amounts of water, sand and cement or lime or gypsum (binder). If too much water is used, the plaster will be hard to apply and will tend to run. Too much sand will weaken a plaster wall because there will not be enough cementing material to bind the mixture together. Extra material is sometimes added to retard the rate at which the plaster sets.

When plaster is mixed by hand in a box, it is thoroughly sifted first to ensure that the mixture is evenly spread. Water is added slowly and the mixture is stirred with a hoe until the proper consistency is reached.

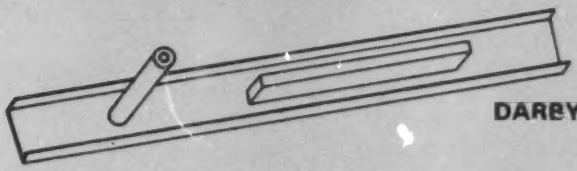
Machine mixing requires that the water be added first, followed by half the sand that will be needed, all the binder and, finally the rest of the sand. Often plaster is left to age after mixing. Water is added to the mixture to replace that lost by evaporation.



PLASTERING TECHNIQUE

The first requirement for applying plaster is the ability to skillfully handle the *trowel and hawk.* Plaster is scooped off the hawk with the trowel and applied to the wall with an upward motion, until all the plaster has rolled off the trowel. The angle at which the trowel is held determines the thickness of the plaster. If the trowel is pressed flat to the wall it will leave a thick layer of plaster. If it is pressed to the wall at an angle it will deposit a thin layer. As each trowelfull of plaster is scooped up, the hawk is turned one quarter turn. This keeps the plaster centered on the hawk, making it easier for the plasterer to handle.

When a fairly large section of wall has been plastered it is smoothed off (darbied). The darby is a long, flat piece of wood or metal with handles. This is held at a slight angle and pushed over



the plaster to smooth and even it up. After a wall has been darbied in one direction, it is darbied at right angles to the first direction.

MAINTAINING PROPER THICKNESS

Plasterers must make sure that the proper thickness of the plaster coat is maintained as their work progresses. To accomplish this, narrow bands of plaster, called screeds, are applied to walls and ceilings, prior to the main coat. They are used as guides to control the thickness of the plaster.

Screeds are plumbed and leveled between small spots of plaster (dots). Several different methods may be used. Sometimes dots are placed on the wall about a straightedge length apart. This is called the rod-and-level-from-a-base ground method. The ground is a length of wood or metal to which moldings can be nailed. Dots of plaster are placed about 6 feet above the floor. The plasterer takes a small block of wood or a piece of paper and embeds it in the dot. Then he takes a straightedge and lays one end of it flat against the base ground and places the other end on the paper or wood on the dot. Then a level is placed vertically along the length of the straightedge. The plasterer presses into the dot until the level shows the straightedge to be exactly upright. Excess plaster is cut away.

A second method for placing dots is called the plumb bob method, employing a plumb bob, a line and two gauges. Gauges transfer a mark from one plane to another. They may be made by cutting wooden strips such as 1 x 2 x 4 inches into identical gauges.

Once gauges are cut, dots are placed on the walls as before. The plasterer holds the gauge on the dot with the plumbline running through the cut out. Then the other gauge is held against the base ground. The upper gauge is pressed into the dot until the plumbline just clears the cut out on the lower gauge. Finally, the plasterer smoothes away whatever excess mortar is left around the indentation.

Once dots have been placed, the plasterer can then set up horizontal screeds or lines of plaster exactly leveled. The plaster is applied slightly thicker than the dots in a 4 inch wide band between the dots. A straightedge, with each end resting on a dot, is smoothed back and forth over the screed until it is exactly level with the dots. A vertical screed is formed by placing mortar between a dot and the ground, and then using the straightedge to smooth and level it.

Dot and screed systems are also placed on ceilings. First, the plasterer fabricates a water level. Water levels are about 50 inches long and made of light plastic or rubber hose. Most levels have an inside diameter of 3/8 or 1/2 inch. Twelve inch long glass tubes are placed in each end of the level. To use the level, the plasterer places it in a pail of clean water and sucks water through the tube until siphoning starts. Once the level is filled, it must be checked to make sure no air is trapped inside it. This is done by holding both ends pointed upward so that the level looks like a large U. If no air is trapped inside, the water levels should be exactly the same height. Within the glasses the water forms a ring around the sides of the tube and then slumps in the middle.

Choose either point to mark by, but always use the same point. The level is used by marking the desired height. Then one tube is held on the mark and the other tube is moved around the room and the level is carefully marked off. Usually, marks are made at 6 foot intervals around the room. Then a ceiling dot and screed system can be installed. First, the plasterer places a dot on the ceiling above each level mark. Then he takes a gauge and places one leg on the mark and the other on the dot. He presses into the dot until the gauge lines up with the mark. Finally, he cuts excess material away from the indentation. Once the dots have dried, screeds are set up between them as on a wall. When the screeds have dried the room is laid out and is ready to be plastered.

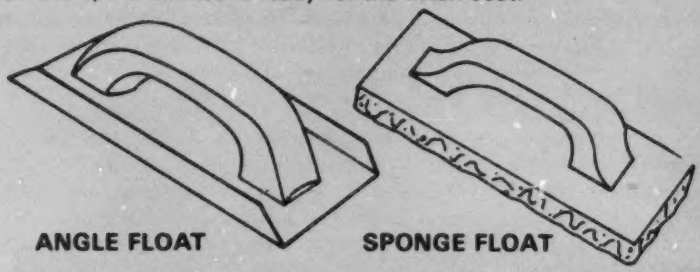
APPLYING THE THREE BASIC COATS

As noted earlier, three coats of plaster are usually applied to the walls of a room: Scratch, brown and finish coat. All these coats are applied in much the same way using the same tools.

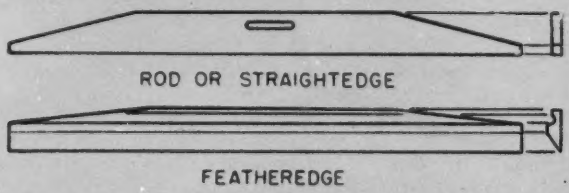
The scratch coat stiffens the lath to form a good foundation for the rest of the plaster. Work begins at the bottom of the wall and moves toward the top. Plaster should be applied with few overlapping strokes. Before the scratch coat sets, the surface is scratched in two directions with the plasterers' rake. For metal lath, the mortar should be rich and thick and applied with a very light pressure. More pressure can be used on paperback gypsum

and wooden lathing. Concrete block must be kept damp while the plaster is being applied. After the scratch coat has set hard, the walls are ready for the second (brown) coat.

The brown coat is used to build up the plaster even with the screeds. A 1/2 to 3/4 inch thick brown coat is used. Brown coat mortar is made thinner than scratch coat mortar. A mixture of 2-1/2 to 1 is usually used with brown coat mortar. The brown coat is applied just as the scratch coat is applied. The surface is rodded level using the screeds as guidelines. Low spots will need to be filled in, then the area should be rodded again. Next, it is darbied horizontally and vertically so that the ridges left by the rod are smoothed out. Finally, the corners of the room are trimmed with a clean trowel. The forward edge of the trowel (toe), cuts away excess plaster on the angle. Some plasterers prefer to use a special tool called an angle float. Once the brown coat has set for about 24 hours, the surface is ready for the finish coat.



Usually the finish coat is applied in two parts. The first coat is a very thin layer of finishing plaster applied directly to the brown coat. Over this coat, a second layer is applied and troweled smooth. Putty coat is the most common finishing plaster used now, and it is applied in seven steps. Plasterers usually apply the finish coat in two-person teams. The first person applies a coat of plaster to each side of each corner in the room. The second member of the team smooths it out with a straightedge. This is called *featheredging*. Then the thin first layer of the finish coat is



applied to all the walls in the room. The second step is to apply the second coat of the finish coat immediately. This coat is worked with the forward edge (toe) of the trowel. Then the plasterer

floats the angles by squaring them up and fills in using an aluminum or plastic float. After this, the entire wall is worked again to remove small surface irregularities (cat faces). The wall is next water troweled. The work is dashed with water from a brush and worked in long up and down strokes holding the trowel at a very sharp angle. Then the plasterer goes over the angles with a trowel or with a small paddle. Last, water is brushed over the entire surface. Once the surface has been brushed with water the job is finished.

Sand finishing is also often used. The procedures used in sand finishing are the same as those used in the putty coat, except that it can be applied over a wet brown coat. Other finish coat materials include Keene's cement and Portland cement.

Often plaster is colored before it is applied. Before a coloring material is mixed in, it should be checked to be sure that it is resistant to lime and that it is waterproof. The problems with colored plasters are that they tend to streak and make it difficult to obtain uniform coloring throughout a room. Colored plasters have advantages in that they are cheaper and coloring makes the plaster easier to work. Colored plasters must be applied to an entire wall at one time, or the boundaries between applications will be visible.

A *textured* surface is sometimes preferred over a smooth one. A stippling brush may be daubed or swirled through the finished plaster to give two different effects. A rubber sponge dabbed on the plaster will give still another effect. Travertine effects are produced by brushing the surface with a wire brush and then troweling it lightly. A trowel finish is formed by moving the trowel back and forth in arcs across the wall. This creates alternating ridges and smooth spots. Sometimes an old fashioned effect is produced by applying plaster with the hands instead of with a trowel.

MARBLE SETTING, TILESETTING AND TERRAZZO WORKING

Marble setters, tilesetters and terrazzo workers cover interior or exterior walls, floors or other surfaces with marble, tile or terrazzo. People in each of these distinct occupations work primarily with the material indicated by their job title.

MATERIALS USED

Bond coat—either a patented tile adhesive or a mixture of pure Portland cement mixed with water. This is troweled directly on the mortar setting bed or is applied to the back of individual tiles immediately before placement into the setting bed.

Brecciated marble—marbles made up of small fragments embedded in a colored paste of cementing material.

Brown coat—see float coat.

Ceramic tile—a thin slab of baked clay, stone or other material.

Float coat—the second coat of mortar applied on a wall for setting tile. It is composed of 1 part cement, 1 part of hydrated lime and 3-1/2 parts sand.

Glazed interior tile—the most commonly used type of ceramic tile. It is 3/8 of an inch thick and usually in 4-1/4 inch or 6 inch squares.

Grant—in ceramic tile application, grant is used in joints. It may consist of Portland cement, lime and sand, or an approved ready-mix, but it should be water resistant and nonstaining.

Leveling coat—see float coat.

Marble—a recrystallization of limestone and dolomite. There are a number of types of marble, such as parian, onyx, vermont, carrara and numidian.

Scratch coat—the first coat of mortar applied on a wall for setting tile. It is at least ¼ inch thick and is composed of 1 part cement to 3 parts sand with the addition of 10 percent hydrated lime by volume of the cement used.

Terrazzo—small pieces of colored stone or marble set in concrete.

Tile adhesive—any of a number of patented Portland cement mixtures furnished by ceramic tile manufacturers for use as a bond coat.

Tile mortar—a mixture of sand, cement and a small amount of lime which is formed into a "bed" in which ceramic tile is set.

Trimmers—variously shaped finishers for the margins, corners and base lines of glazed interior tile.

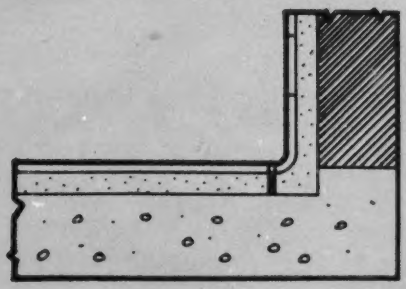
MARBLE SETTERS

Marble setters install marble, shop-made terrazzo panels, artificial marble and structural glass in building interiors. The marble setter does little fabrication work, because the marble and other materials are cut to size and polished before they are delivered to the worksite. Some minor cutting to make the materials fit exactly may be necessary. In setting marble, the work is laid out, anchor holes are drilled in the marble for wall-work, nonferrous anchors (usually brass or copper) are fastened to the marble, a special plaster mixture is applied to the backing material and the marble is set by pieces in place. When necessary, the marble is braced until the setting plaster has hardened. Special grout is packed into the joints between the marble pieces, and the joints are slightly indented (pointed up) with a pointing trowel or wooden paddle. Bolt holes need to be drilled if attachments to the marble are necessary, and for the installation of all marble toilet and shower compartments.

The setting of marble on floors involves the preparation of Portland cement mortar, applying sufficient mortar for one piece of marble, placing the marble on the mortar and tamping it to the proper elevation. The marble setter then removes the marble piece, brushes or trowels a coat of neat cement to the back surface, resets the piece of marble on the setting bed and retamps it to the proper line and elevation. Each marble setter normally has a helper to prepare plaster, carry marble slabs and clean the completed work.

TILE AND TERRAZZO

Tile and terrazzo setters cover inside or outside walls, floors or ceilings with tile or terrazzo according to blueprints. Tile is a thin slab of baked clay or stone. On walls and ceilings, the tilesetter



places a setting bed to support the tile being placed. The setting bed is made up of a layer of mixed sand, cement and a small amount of lime. The tile is actually bonded, or held in place, by a thin layer of pure Portland cement mixed with water. The bond coat is either troweled onto the setting bed or onto the back of each tile. The tile is then tapped into piace with the trowel handle. When tile is laid on a floor, the setting bed is tamped and then screeded, or leveled with a straightedge to the right elevation. Once the proper elevation is reached, a layer of pure Portland cement is brushed onto the setting bed and dampened. The tile is then set and tapped into place. At some places, in corners and around pipes, tile must be cut to size. After the tile is set, the joints are filled with grout, a Portland cement mortar and dampened. Finally, the tile faces are wiped with a damp cloth or sponge to remove excess grout.

Terrazzo is an ornamental cement containing marble chips and used mostly on floors. Terrazzo workers start off by laying a base of concrete mortar. This base is leveled with a straightedge. A metal strip is laid in the form wherever there is to be a joint or a change in color. Once the forms are laid, the terrazzo worker mixes up the final batch of terrazzo mix and pours it onto the base. Then it is rolled and leveled. It is left to harden for a few days. Then it is ground and polished with polishing machines. These are the major steps used in tile and terrazzo setting.

CUTTING AND FITTING TILE

The first thing the tile setter needs to know is how to cut and fit tile to a desired size. The tile setter marks off the length of tile to be cut with a ruler and a pencil. Then with a pencil and a straightedge, a line is marked off on the tile from edge to edge on both sides. Using a glass cutter, the tile setter scratches a line along the mark made on the tile. Then the tile is laid over an 8d (penny) finishing nail with the scratched surface directly on the nail. The tile setter presses the tile with his hands on both sides of the tile to break it. The broken edge of the tile should be polished with a carborundum stone or electric polishing wheel. Sometimes a tile needs to be cut in a curve rather than in a straight line to fit around a pipe. First, the centerline of the pipe should be scratched on the tiles with a glass cutter. Then the outline of the pipe should be marked off with a pencil on the tile. Using the penciled outline as a guide, the outline of the pipe should be scratched with a glass cutter. Then the area outlined should be nibbled away with glass pliers or glass nippers until a hole outlining the pipe appears. Finally, the edge of the cut is smoothed off with carborundum or an electric grinding wheel.

SETTING TILE

After the tile setter cuts tile to the proper dimensions, it may be laid on both cement and mastic (plastic or asphalt) setting beds. The tile setter checks the base of the tile rows with a spirit level to find the highest point. Once the highest point is located, a perpendicular line is drawn 4-3/8 inches high from this point. This length is the width of the tile plus 3/8 inch. Then another line, at an exact right angle to the 4-3/8 inch line, is drawn all around the base of the wall to be tiled, and at 4-3/8 inches above the high point of that base. The tile setter takes primer paint and paints the wall of the room. Primer paint prepares the base wall to receive the adhesive. The particular type of primer to be used will be recommended by the tile manufacturer. Then with a spatula or trowel, the tilesetter applies adhesive to the back of the tile and presses it into place with its top exactly along the guideline. Each successive tile is butted up against the spacer lugs on its predecessor. Once the first course is laid it should be checked with a level. Then with a spatula or notched trowel the tile setter applies adhesive to the wall for the next course. Once tile has been set on a wall, the tile setter then grouts them. The grout is brushed or troweled into the spaces between tiles and binds them together.

There are several relatively simple steps used in applying grout. First, the tile is allowed to set for 24 to 36 hours before grouting. Next the joints, or spaces between the tiles are dampened with a small sponge and clean water. The tile setter takes a clean bucket containing a small quantity of clean water, and adds Portland cement until the mixture is thick as cream. A brush or a sponge is dipped into the mixture, wiping it across the face of the tiles. After the grout has set for a few minutes, the tile setter takes a toothbrush handle and begins working the grout into the joints by drawing the toothbrush handle down the joint. The grout begins to set and the face of the tile is wiped with a clean damp sponge. Finally, the joint is sprayed down with a fine water mist and the tile is dried.

If the tile has been set above or around a bath tub or sink, the joint between the tile and the butt is caulked with a sealing compound. There is a wide variety of such sealing compounds on the market, each of which has a different set of directions for its use.

APPLYING CERAMIC TILE

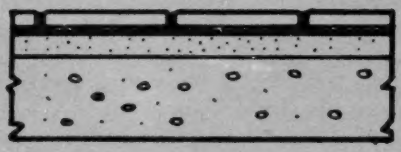
Ceramic tile is often attached to a wall with mortar. Where mortar is used, tile may be attached to some sort of lathing (usually metal) material, such as that which is used with plaster. The first step in applying tile with mortar is laying it out properly. On a vertical wall surface, the tile setter should first figure how many

tiles will be needed in each course. Then the course is centered so that the fewest cuts possible are made. Tiles should always be cut in pairs, so that the first tile and last tile in a row are of equal size. The tile setter should lay out the courses before doing anything else. Once the courses are laid out, the tile setter is ready to prepare the backing to receive the tile. Loose paint and plaster on the wall should be scraped away before the scratch coat is applied. Then strips of 15 pound building felt should be attached to the wall. Finally, the lath should be placed over this and fastened to the wall with nails or staples. A scratch coat should be applied, which consists of one part Portland cement to1-1/2 parts of fine sand. The scratch coat should be troweled on smoothly and evenly, and checked with a spirit level after drying. If the scratch coat varies more than 1/4 inch per 8 feet, a leveling coat should be applied. The scratch coat is mixed and applied with long, even trowel strokes. Finally, whatever excess mortar is left on the wall is removed with a 4 to 6 foot straightedge.

The float coat is allowed to dry and is then ready for tile application. The tile should be soaked for about 1/2 hour, and the float coat should be dashed with water. Pure Portland cement should be mixed in a clean container with clean water and allowed to sit for 20 minutes, then remixed to a creamy consistency. The cement should be troweled on 1/32 to 1/16 inch thick with long, even trowel strokes. A leveled screed strip should run all around the room. The tiles should be applied in a level row and tapped into place with a flat rubber-covered block. The tile should be set four rows at a time and the process repeated. Once the tile dries, it should be grouted. Grout should be applied in the same way as with tile set in any other way.

SETTING FLOOR TILE

In addition to setting tile on vertical walls, tile setters often set tile floors. There are several different methods used in laying out and installing tile floors. The subfloor must first be properly prepared for the tile by sweeping all loose trash off the floor and measuring it carefully. Next, mortar screed strips should be placed on the floor and leveled with a water level or transit. Usually, mortar is mixed with one part Portland cement to five parts of sand. It should be troweled onto an area small enough so that tile can be



laid before it begins to set. The mortar should be laid about 1 inch thick and should be smoothed and evened with trowel strokes. Mortar should be just damp enough to wet a layer of Portland cement spread across the surface. This layer of Portland cement should be dusted on right before the tile is laid.

INSTALLING CERAMIC FLOOR

There are two ways to lay a floor and both methods start with the longest straight wall in a room. In one method the tile setter snaps a chalkline and lays a row of tiles absolutely straight along the master wall. Then, with a 10 foot straightedge (storypole) as a guide, the tile setter marks off the location of each tile to be set with a set of dividers or a marked stick the exact length of one tile plus one joint. This course is laid out perpendicular to the master wall. Finally, the tile setter mortars and sets the tile in the row (leg) perpendicular to the master wall. The other method of laying tile floors does not use legs. Tile setting without legs is done with a storypole and two layout sticks exactly 3 tiles plus 3 joints long and marked off in tile and joint lengths. A line should be stretched out parallel to the master wall and exactly one tile length away from it. The straightedge should be placed perpendicular to the master wall. Where it goes under the line, a nail should be driven. A row of tile should be laid against the straightedge. Then, with the two layout sticks, the storypole should be moved up 3 rows and another course of tile laid. The area between the two courses should then be filled in with courses of tile and the process should continue. As each course is completed, it should be tapped into place using a rubber covered wooden block. When the tile setter must put weight on the newly laid tile, a kneeling board should be used so that weight will be distributed evenly and will not put a dent in one part of the floor. Kneeling boards should be less than 12 inches wide and weight should not be placed on the edge of

them. Once the floor is laid, it should be grouted. The process for mixing and applying grout to floors is the same as that used for applying grout to vertical walls.

INSTALLING TERRAZZO FLOOR TILE

Terrazzo floor installation is somewhat different. Tile laying is done with a ready made product which is fastened to a floor while terrazzo working builds the floor and its design up from scratch. The first step in laying a terrazzo floor is to make and prepare an underbed for what is called an *unbonded terrazzo floor.* As a base for the underbed there should be a Portland cement subfloor which would be at least 21 days old. This subfloor should be smooth troweled and a clean layer of sand 1/16 to 1/4 inch thick should be spread over it. After the sand is spread it is screeded with a straightedge. The terrazzo setter lays polyethylene sheets over the sand. Separate sheets should overlap by 4 inches at the joints. Reinforcing lath is laid out over the plastic metal and should be overlapped by two mesh spaces and wired together. Then the windows or forms for the mortar are built and put into place. The mortar is mixed with one part of Portland cement to four or five parts of sand. Just enough water is added to make a good stiff mortar. Once the mortar is mixed, the polyethylene sheet should be dampened and the mortar poured. The wire mesh is raised so that about 1 inch of mortar lies beneath it before troweling and screeding. It should be left to set until it is semi-solid. When semi-solid, the divider strips are installed. They should be set and aligned with a straightedge and set exactly even with the elevation of the finished floor. Each strip should be troweled along the edges to make sure it is firmly embedded. After the strips have been installed and the underbed has hardened for 12 to 24 hours, the terrazzo is ready to mix and pour. First, a creamy mixture of water and pure cement is troweled onto the underbed before the terrazzo mix is made. For each 94 pounds of Portland cement there are 200 pounds of marble chips. It is mixed in a concrete mixer with 5 to 5-1/2 gallons of water. The mixture is poured onto the underbed and troweled down even with the tops of the divider strips. Extra marble chips are soaked in water and troweled in. Finally, the floor should be rolled with a heavy roller to press out excess water and troweled a second time. Then this surface is set cured for 3 to 7 days by covering it with a watertight cover or with a curing compound. After 3 to 7 days the surface is covered with water and ground with a terrazzo grinding machine using a No. 24 grinding stone. The chips are swept away and a creamy grout mixture is troweled over the surface and into hollows and depressions. The surface is wet cured another 3 days and then ground with a No. 80 grind stone

to remove the grout surface. The floor is cleaned with a neutral cleansing compound and rinsed before sealing compound is applied to the surface. Finally, the floor is covered with building paper until the floor is ready for use.

Several other ways of installing terrazzo floors also exist. One of these methods is called thinset application. Another is called monolithic installation. Thinset is done with marble chips embedded in a resin rather than concrete base. This application requires a concrete subfloor at least 21 days old. It should be level to within 1/3 inch variation in 10 feet. Divider strips 10 to 15 feet long are installed. Once the divider strips are installed, the marble chips and resin are mixed and poured. The mixture then is troweled and extra chips are added and troweled in, if necessary. After the mixture sets for 1 to 3 days, it is wet down and ground with a terrazzo grinding machine.

A monolithic terrazzo floor is sort of a bonded terrazzo floor held together by concrete. It must be laid on a concrete subfloor. The concrete topping bonds itself to the concrete subfloor in this method. Before beginning work, the terrazzo setter should make sure that the subfloor is at least 3-5/8 inches thick. The subfloor should be swept with a metal brush or broom to make the surface rough enough to bond with the topping coat. This brushing serves the same purpose that scratching a plaster coat serves. Next, the concrete slab should be cut with a power saw and divider strips should be installed. The slab surface is scrubbed with detergent and then rinsed. Next, water should be left in a puddle on the slab overnight before the topping is poured and then squeezed off. Portland cement mixed with water and colored to the color of the topping coat should be applied to the slab. The topping should be mixed in a concrete mixer with 5 to 5-1/2 gallons of water. If extra marble chips are needed, they should be troweled in. The surface is rolled with a heavy roller to squeeze out excess water, then covered and wet cured 3 to 7 days. After this, the surface should be covered with water and ground with a No. 24 grinding stone. Grout is mixed and troweled onto the surface and then wet cured for about 3 days. Finally, the surface is ground again with a No. 80 grinding stone. The surface should be cleaned with a liquid neutral cleanser and rinsed. After the new floor dries, it should be covered until it is ready to be used.

EMPLOYMENT

Total employment in marble setting, tilesetting and terrazzo working is expected to increase mainly because of the anticipated expansion in construction activity. However, the rate of employment growth will vary sharply among these occupations.

The demand for terrazzo workers is expected to increase rapidly. Because terrazzo is durable and attractive, the number of terrazzo installations is expected to increase substantially. Growth of the trade also will be stimulated by the use of new terrazzo materials, especially epoxy and latex terrazzo. These products, which are lighter and occupy less space than cement-based terrazzo, are being used increasingly, especially on the upper floors of multi-storied buildings.

SAFETY

BRICK

Brick should never be piled directly on uneven or soft ground but should always be stacked on planks. Brick must never be stored on scaffolds or runways. This does not prohibit normal supplies on bricklayers' scaffolds during actual bricklaying operations.

Except where stacked in sheds, brick piles should never be more than 7 feet high. When a pile of brick reaches a height of 4 feet it must be tapered back 1 inch in every foot of height above the 4 foot level. The tops of brick piles must be kept level and the taper maintained during unpiling operations.

MASONRY BLOCK AND HOLLOW TILE

Blocks should always be stacked in tiers on solid level surfaces. Stacked piles should be limited to a height of 6 feet whenever possible. When blocks are stacked higher than 6 feet, the pile must be stepped back, braced and propped, or wood strips placed between tiers to prevent the pile from toppling.

Blocks should not be dropped or thrown from an elevation or delivered through fully enclosed chutes.

CEMENT AND LIME

Goggles and snug fitting neck and wrist bands should be worn when handling cement and lime bags. Clothing that has become hard and stiff with cement should not be worn because such clothing can irritate the skin and cause serious infection.

Bags of cement and lime should not be piled more than 10 bags high on a pallet except when stored in bins or enclosures built for such purposes. The bags around the outside of the pallet should be placed with the mouth of the bags facing the center. To prevent piled bags from falling outward, the first five tiers of bags each way from any corner must be crosspiled and a set-back made commencing with the sixth tier. If necessary to pile above the tenth tier, another set-back must be made. The back tier, when not resting against a wall of sufficient strength to withstand the pressure, should be stepped back one bag every five tiers, the same as the end tiers.

During unpiling, the entire top of the pile should be kept level and the necessary step-backs every five tiers maintained.

Lime must be stored in a dry place to prevent a premature slaking action hydration.

CONCRETE PLACEMENT AND FORM CONSTRUCTION

Form construction and concrete placement have peculiarities in each job, but, certain natural conditions will prevail in all situations. Wet concrete will always develop hydrostatic pressure and strain on forms. All stakes, braces, walers, ties and shebolts should be properly secured before placing any concrete.

The use of safety belts by personnel tying reinforcing bars in high places will speed up the job and provide safety at all times.

Careless nailing and exposed nails in form work cause accidents. All nailing should be correctly placed and secured.

All personnel should wear hard hats, shirt sleeves should be rolled down and gloves should be worn. These precautions are for "safety first" and also to assist in decreasing the exposure of skin to "cement poisoning."

If concrete buckets and cranes are used in pouring, each bucket should be provided with a tag line or two, depending on the location. A free swinging concrete bucket should never be ridden during a pour.

Adequate scaffolding should be built to permit men to stand clear of working areas.

Mud sills should be placed under shoring that rests on the ground.

Raising of large form panels should not be attempted in heavy gusts of wind either by hand or by crane.

Only people actually engaged in stripping the forms should be permitted in the immediate work area.

Stripped forms should be piled immediately to avoid congestion, exposed nails and other hazards.

Wires under tension should be cut with caution to avoid backlash.

PLASTERING

The observance of safety rules in plastering or stuccoing cannot be overemphasized. To help prevent accidents and harm to others, follow these safety hints:

- All materials in bags or bundles should be stacked, blocked, interlocked and limited in height so that the pile is stable and secure against sliding or collapsing.
- Material stored inside a building under construction should be placed not less than 6 feet from hoistways or other inside floor openings.
- Bags of cement and lime should not be stacked more than 10 bags high without set-back, unless restrained by walls of appropriate strength.
- The outside row of bags should be placed with the mouths of the bags facing the center of the stack.
- During unstacking, the entire top of the stack must be kept nearly level and maintain the necessary set-backs.
- Handle paper sacks with care to prevent breaking and showering persons with cement and dust.
- Store lime and cement on off-the-floor platforms in dry places. Lime must be kept dry to prevent possible premature slaking which could cause fire.
- Wear heavy gloves when handling metal lath.
- Wear goggles for eye protection when handling cement and lime.
- Wear shirts with closed neck and wrist bands and be sure that exposed parts of the body do not come in direct contact with lime.
- Avoid wearing clothing which has become stiff and hard with cement or lime since such clothing irritates the skin and may cause infection.
- Wear goggles, gloves and other protective clothing and equipment when handling muriatic acid.
- Practice personal cleanliness and frequent washing which are effective in preventing skin ailments.

AFTER SCHOOL

INTRODUCTION

Toward the end of your senior year you will need to make a decision as to whether you want to seek additional training in the masonry occupation of your choice or go directly to work. Even though you probably have a fairly accurate assessment of your capabilities, it would be wise to discuss your next move with your instructor or counselor.

If you decide to go directly to work, you will need to ask yourself several questions. Where do I want to locate? What kind of company do I want to work for? What type of working conditions do I desire? As much as possible, know what you most want out of going to work. Use this information as a goal, and set your mind to achieving it.

GOING DIRECTLY TO WORK

BRICK AND BLOCK LAYING

The great majority of bricklayers work mainly on new construction. Some are employed also in sewer construction to build manholes and catch basins. In addition, bricklayers do a considerable amount of alteration work, especially in the larger cities where construction of fire-resistant partitions, store front remodeling and similar modernization work is often done. They also do a substantial amount of maintenance and repair work.

Bricklayers also work for such industrial establishments as factories making glass or steel, where furnaces and kilns require special fire brick and refractory brick linings. For example, in a steel manufacturing plant, the bricklayer lines converters, cupolas and ladles which hold molten metal. Bricklayers ordinarily must have additional training to do refractory brick work.

Hourly wage rates for bricklayers rank among the highest in the building trades, according to a national survey of building trades workers in 68 large cities. Although high hourly rates indicate high annual incomes for bricklayers, time lost because of inclement weather and occasional periods of unemployment between jobs, make average annual earning less than hourly rates of pay imply.

The work of the bricklayer is active and sometimes strenuous like the work in other building trades. It involves stooping to pick up materials, moderately heavy lifting and prolonged standing. Most of the work done is outdoors.

A bricklayer must have an eye for straight lines and proportions. Good physical condition and manual dexterity are important assets. Since other building people must usually fit their work to the bricklayer, this person should know how the parts of a structure are put together.

Bricklayers may advance to jobs as supervisors. They also may become estimators for bricklaying contractors. Estimators compute material requirements and labor costs. Some advance to the position of bricklaying superintendent on large construction projects while others may start their own bricklaying contracting business.

CONCRETE MASONRY

Concrete masons work principally on large buildings, but many are employed on highway or other nonbuilding construction. These masons work directly for general contractors who construct entire projects such as highways, or large industrial, commercial

and residential buildings. They also work for concrete contractors, who do only the concrete work on a large construction project, or who work on smaller projects such as sidewalks, driveways and basement floors. Some install composition resilient floors, such as trowel applied epoxies, latex underlayments and simulated terrazzo floors for specialty floor contractors. A small number are employed by municipal public works departments, public utilities and manufacturing firms which do their own construction. Some masons are self-employed and do small concrete jobs, such as sidewalks, driveways, patios, and curb and gutter work.

Concrete masons usually receive premium pay for hours worked in excess of the regularly scheduled workday or workweek. Overtime work for these people often occurs because once concrete has been placed, the work must be completed.

Since most concrete finishing is done on floors or at ground level, the mason is required to stoop, bend or kneel. Much of masonry work is done outdoors.

PLASTERING

Most plasterers work on new construction. In addition, these craftsmen work on extensive building alterations, particularly where special architectural and lighting effects are part of the building modernization. Some work for plasterers is found in the repair and maintenance of older buildings.

A large proportion of plasterers are members of unions. They are represented by either the Operative Plasterers' and Cement Masons' International Association of the United States and Canada, or the Bricklayers, Masons and Plasterers' International Union of America.

Plasterers may advance to supervisor, superintendent or estimator for a plastering contractor. Many plasterers are self-employed and they may employ other plasterers.

MARBLE SETTING, TILESETTING, AND TERRAZZO WORKING

Marble setters, tilesetters and terrazzo workers are employed mainly in new building construction and in the large urban areas. Substantial numbers of terrazzo workers are employed in Florida and California.

Marble setters and terrazzo workers work both indoors and outdoors, depending on the types of installation. Tile setters work mostly indoors.

A large proportion of the workers in each of these trades are members of one of the following unions — Bricklayers, Masons

and Plasterers' International Union of America; and International Association of Marble, Slate and Stone Polishers, Rubbers and Sawyers; Tile and Marble Setters' Helpers; and Marble, Mosaic, and Terrazzo Workers' Helpers.

MORE EDUCATION

BRICK AND BLOCK LAYING

Most training authorities, including the National Joint Bricklaying Apprenticeship and Training Committee, recommend the completion of a 3-year apprenticeship program as the best way to learn this trade. Many brickmasons have acquired bricklaying skills informally by working as helpers or hod carriers, observing or being taught by experienced bricklayers. Many of these persons have gained additional knowledge by taking vocational school courses.

Apprenticeship applicants are generally required to be between 17 and 24, but this requirement may be waived for veterans. A high school education, or its equivalent, is desirable. The ability to solve arithmetic problems quickly and accurately is an asset.

The apprenticeship program generally consists of 6,000 hours (3 years) of on-the-job training, in addition to related classroom instruction. In a typical 3-year bricklayer training program, the apprentice learns to use, care for and handle safely the tools, machines, equipment and materials commonly used in the trade; lay, bond and tie brickwork; build footings and foundations; do exterior brickwork, such as straight wall work, steps and arches; build columns, piers and corners; plan and build chimneys, fireplaces and hearths; lay stone; point brick and stone; clean stone, brick and tile using acid solution and by sandblasting; cut, set and point concrete and cinder blocks, artificial stone and glass blocks; and fireproof and waterproof structures.

The apprentice receives related classroom instruction in blueprint reading, layout work, measurement, sketches and welding. Some apprenticeship programs conduct actual welding instructions that qualify trainees as bricklayer-welder upon completion of their training. The apprentice trainee learns the relationship between bricklaying and other building occupations.

In some areas, formal apprentice training for bricklayers includes brief preliminary instruction at a vocational school or some other type of prejob instruction. This training is designed to give the apprentice a basic knowledge in the handling of tools and materials to prepare for the start of on-the-job training.

Hourly wage rates for bricklayer apprentices generally start at 50 percent of the journeyman rate and increase periodically until 95 percent of the journeyman's rate is reached during the last period of apprenticeship.

CONCRETE MASONRY

A substantial number of concrete masons have acquired their skill informally by working on building and road construction jobs as laborers assisting concrete masons. Others have worked with specialty contractors constructing sidewalks and doing other masonry.

A formal apprenticeship program is often recommended as the best way to learn the skills required of a concrete mason. Apprenticeship applicants generally are required to be between 18 and 25. Good physical condition and manual dexterity are important assets.

The apprenticeship program usually consists of 6,000 clock hours (3 years) of on-the-job training, in addition to related classroom instruction. During the apprenticeship period, the apprentice learns to use and handle the tools, equipment and materials of the trade.

Apprentices also learn finishing, layout work and safety techniques. The apprentice receives related classroom instruction in subjects, such as applied mathematics and related sciences, blueprint reading, architectural drawing, estimating materials and costs and local building regulations. Although a high school education is not required, education above the grade school level, preferably including mathematics, is needed to understand the classroom instruction.

PLASTERING

Apprenticeship programs in plastering generally consist of 6,000 to 8,000 clock hours (3 to 4 years) of on-the-job training, in addition to at least 144 hours of related classroom instruction annually. In a typical 4-year training program, the apprentice learns to use and handle the tools of the trade and the properties

and appropriate handling of the different kinds of materials and mixtures used in plastering. In addition, apprentices learn to apply scratch (first) coat and brown (second) coats; align walls and beams to given measurements; apply white coat and sand finish; install acoustical plaster, stucco and similar materials. The apprentice learns to use machines to apply and finish plaster; lay out arches and ceilings; do texture finishing.

The apprentice receives classroom instruction in subjects as drafting, blueprint reading and mathematics applicable to layout work. In the classroom and on the job, the apprentice becomes familiar with the work of other trades so that he may determine whether lathing or other preparatory work is satisfactory.

Apprentice applicants in plastering are required to be between 17 and 25, but this requirement may be waived for veterans.

Significant numbers of plasterers have acquired their skills by working as helpers or laborers, observing or being taught by experienced helpers. As in other masonry occupations, a formal apprenticeship program is recommended.

MARBLE SETTING, TILESETTING AND TERRAZZO WORKING

Completion of a formal, three year apprenticeship program is recommended for each of these occupations. Apprenticeship applicants generally are required to be between 17 and 22 and a high school education or its equivalent is desirable. Good physical condition and manual dexterity are important assets. Applicants should have an eye for quickly determining proper alignments of tile, terrazzo and marble and have a good sense of color harmony.

The apprenticeship programs in each of these trades generally consist of 6,000 clock hours of on-the-job training, in addition to related classroom instruction. In typical 3-year training program for terrazzo workers, apprentices learn to use, care for and handle safely the tools, equipment and materials commonly used in the trade; mix, place, tamp and level concrete and terrazzo material; select, set and level metal dividing strips. The apprentice also learns the selection and placement of materials according to the design of the job; the rough and final finishing of bases and covers; hand and machine rubbing.

The apprentice receives related classroom instruction in blueprint reading, layout work, basic mathematics and shop practice.

Hourly wage rates for apprentices in each of these trades start at about 50 or 60 percent of the journeyman rate and increase periodically until 95 percent of the journeyman rate is reached during the last period of apprentice training.

TOOLS AND EQUIPMENT

Bolster—a device used for smoother cutting of brick than is possible with an ordinary mason's hammer.

Brickcutting chisel—see bolster.

Brick set—see bolster.

Brick trowel—a pointed steel blade about 5 inches wide at the heel and 10 inches long. At the wide end, a wooden handle is fastened to the blade by means of a tang. The tang is bent upward slightly so that the handle is slightly above the blade in use. The blade of the trowel is used to scoop and spread mortar and to chip and cut bricks. The end of the handle is used to tap bricks into place.

Cement trowel—a flat rectangular blade about 4 inches wide and 14 inches long fastened to a wooden handle. While concrete is still wet, the cement trowel may be pushed into place and uneven spots leveled by moving the concrete with the edge of the trowel.

Concrete mixer—a gasoline-powered machine generally consisting of a frame equipped with wheels and towing tongue for easy movement, an engine, a power loader skip, mixing drum, water tank and auxilliary water pump.

Concrete saw—a device used to cut longitudinal and transverse joints in finished concrete pavements. Several types of blades are available, the most common of which have either diamond or carborundum cutting surfaces.

Darby—a float with an extra-long blade, equipped with handles for two-handed manipulation.

Dry mix pump—a plastering machine which carries dry ingredients to a mixing nozzle where water under pressure combines with the mix and provides spraying force.

Featheredge—a tool similar to the rod, except that the blade tapers to a sharp edge. It is used to cut in corners and to shape sharp, straight lines at corner lines of intersection.

Float—a wooden or metal tool used to eliminate high spots, fill in low spots and bring enough mortar to the surface to produce the desired concrete finish.

Hawk—a square, lightweight sheet metal platform with a vertical central handle, used for carrying mortar from the mortar board to the place where it is applied.

Jointer—a device used for making various joint finishes in masonry.

Masonry drills—shafts of steel with a cutter at one end and a flat face on the other. They are used for drilling holes in concrete and are available in various sizes up to 1-3/4 inches in diameter and 18 to 48 inches in length.

Mason's hammer—a hammer used for breaking into bats and closures with the chisel peen, and splitting and rough breaking with the head or flat.

Mechanical trowel (power trowel)—an electrically operated rotating trowel which weighs about 6 pounds and resembles a 6-bladed fan.

Plaster floats—tools glided over the suface of plaster to fill voids and hollows or to level bumps left by previous operations and to impart a texture to the surface. The *wood float* has a wooden blade, and the *angle float* has a stainless steel or aluminum blade. The *sponge float* is faced with foam rubber or plastic, intended to impart a certain surface texture. A *carpet float* is similar to a sponge float, but faced with a layer of carpet material. A *cork float* is faced with cork.

Rod—a wood or lightweight metal blade 6 inches wide by 4 to 8 feet long. This is the first tool used in leveling and straightening applied plaster between the grounds. A wood rod has a slot for a handle cut near the center of the blade. A metal rod usually has a shaped handle running the length of the blade.

Spading tool—a hand device used in concrete consolidation.

Straightedge—see rod. (For concrete slabs, rod should be about 2 feet longer than distance between forms.)

Tremie—a pipe having a funnel-shaped upper end into which concrete is fed in operations involving placing concrete in water.

Vibrating screed—a device consisting of a beam or beams with a gasoline engine or an electric motor and vibrating mechanism which is generally mounted in the center of the beam. Vibratory finishing screeds permit the use of stronger and more economical, low slump concrete as they strike off this relatively dry material smoothly and quickly.

Vibrator—a mechanical device which is very effective in concrete consolidation. Vibrators may be powered by electricity, gasoline or compressed air and are available for either internal or external use. The internal vibrator involves insertion of the vibrating element into the concrete. The external type is applied to the forms.

Wet mix pump—a plastering maching which carries mixed plaster from the mixing machine to a hose nozzle.

GLOSSARY

Abrasion resistance—a general index of aggregate quality, which is essential when the aggregate is used in concrete subject to abrasion, as in heavy-duty floors.

Accelerating admixtures—materials which speed up the setting and the strength development of concrete.

Admixtures—chemical compounds and other substances which can be added to concrete during mixing operations to improve the concrete in a certain way for the job being done.

Aggregate—the ingredient in concrete which reduces the shrinking tendencies of cement while increasing the strength of concrete.

Base coat—each of the lower layers of plaster, if more than one coat is applied.

Bed joint—the horizontal layer of mortar on which a masonry unit is laid.

Bond—the property of a hardened mortar that knits the masonry units together.

Brick masonry—type of construction in which units of baked clay or shale of uniform size, small enough to be placed with one hand, are laid in courses with mortar joints to form walls of virtually unlimited length and height.

Brown coat—the second coat of plaster or stucco in three-coat work.

Bull-header—a rowlock brick laid with its longest dimension perpendicular to the face of the wall.

Bull-stretcher—a rowlock brick laid with its longest dimension parallel to the face of the wall.

Concrete—an artificial stone made by mixing cement and sand with gravel, broken stone or other aggregate. These materials must be mixed with sufficient water to cause the cement to set and bind the entire mass.

Control joints—continuous vertical joints built into concrete walls to control cracking resulting from unusual stresses. The joints are intended to permit slight wall movement without cracking.

Corbeling—courses of brick set out beyond the face of a wall in order to form a self-supporting projection.

Courses—one of the continuous horizontal layers (rows) of masonry which form the masonry structure.

Course pole—a board with markings 8 inches apart which is used to determine the top of the masonry for each course of a wall under construction.

Curing—the process of protecting concrete against loss of moisture during the earlier stages of setting.

End shell—each of the recessed ends of a concrete block.

Face shell—each of the long sides of a concrete block.

Finish coat—the top layer of plaster if the plaster is applied in more than one coat.

Flashing—the waterproof covering placed at certain points in brick masonry to hold back water or to direct any moisture outside of the wall.

Gradation—the distribution of particle sizes, from coarse to fine, in a given sample of fine or coarse aggregate.

Grout—a water-cement, or water-cement-sand mixture, used to plug holes or cracks in concrete, seal joints, fill spaces between machinery bed plates and concrete foundations, and for similar plugging or sealing purposes.

Header—a masonry unit laid flat with its longest dimension perpendicular to the face of the wall. It is generally used to tie two withes of masonry together.

Hydration—the chemical reaction which occurs when water is added to cement, causing it to harden.

Keene's Cement—a type of gypsum plaster in which crushed gypsum rock is heated until nearly all of the water of crystallization is driven off. This plaster produces a very hard, fine-textured finish coat.

Laitance—a surface layer of weak material left on concrete whenever there is too much water in the concrete mixture.

Masonry—a construction made up of prefabricated masonry units laid in various ways and joined together with mortar.

Mortar—a mixture of cement, sand and water without coarse aggregate. It is used chiefly for bonding masonry units together.

Pointing—the process of inserting mortar into horizontal and vertical joints after a masonry unit has been laid.

Portland Cement—a number of types of cement with unique characteristics manufactured from limestone and mixed with shale, clay or marl.

Precast concrete—any concrete member that is cast in forms at a place other than its final position of use.

Putty coat—see white coat.

Retarding admixtures—materials sometimes used in concrete to reduce the rate of hydration to permit the placement and consolidation of concrete before the initial set.

Rowlock—a brick laid on its edge (face).

Scratch coat—the first coat of plaster or stucco.

Screeding—the process of leveling the surface of a concrete slab by striking off the excess concrete.

Segregation—the tendency of particles of the same size in a given mass of aggregate to gather together whenever the material is being loaded, transported or otherwise disturbed.

Shell—the sides and recessed ends of a concrete block.

Slump test—a method of measuring the consistency of concrete. The results of a slump test give a valuable indication of the cohesiveness, workability and placability of a mix.

Soldier—a brick laid on its end so that its longest dimension is parallel to the vertical axis of the face of the wall.

Stirrups—small U-shaped bars used to supplement bend bars in resisting diagonal tension and to reinforce the web in a beam in reinforced concrete.

Stretcher—a masonry unit laid flat with its longest dimension parallel to the face of the wall.

Trig—a short piece of line looped around the main line and fastened to the top edge of a brick that has been previously laid in proper position.

Water-reducing admixtures—a material used for the purpose of reducing the quantity of mixing water required to produce concrete of a given consistency.

Web—the material which forms the partitions between the cores of a concrete block.

White coat—finish plaster made of gypsum gauging plaster and lime putty.

Withe—a continuous vertical 4 inch or greater section of masonry, as the thickness of masonry separating flues in a chimney.

APPENDIX

BRICK AND BLOCK LAYING

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ADDITIONAL SOURCES OF INFORMATION

Bricklayers, Masons, and Plasterers International Union of America
815 16th Street, N.W.
Washington, D.C. 20005

Brick Institute of America
1750 Meadow Road
McLean, Virginia 22101

CONCRETE MASONRY

Apprentice Training for Masons, (National Concrete Masonry Association: P.O. Box 9185, Rosslyn Station, Arlington, Virginia 22209).

ADDITIONAL SOURCES OF INFORMATION

Prestressed Concrete Institute
20 North Wacker Drive
Chicago, Illinois 60606

Flexicore Manufacturers Association
2116 Jefferson Street
Madison, Wisconsin 53711

Portland Cement Association
Old Orchard Road
Skokie, Illinois 60076

PLASTERING

Felicien Van Den Branden and Thomas L. Hartsell, *Plastering Skill and Practice*, (American Technical Society: 848 East 58th Street, Chicago, Illinois 60637), 1953.

Jack Rudman, *Civil Service Exam Passbook: Plasterer*, (National Learning Corporation: 20 DuPont Street, Plainview, New York 11803).

ADDITIONAL SOURCES OF INFORMATION

Operative Plasterers and Cement Masons International Association
1125 17th Street, N.W.
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ARTICULATION GUIDE

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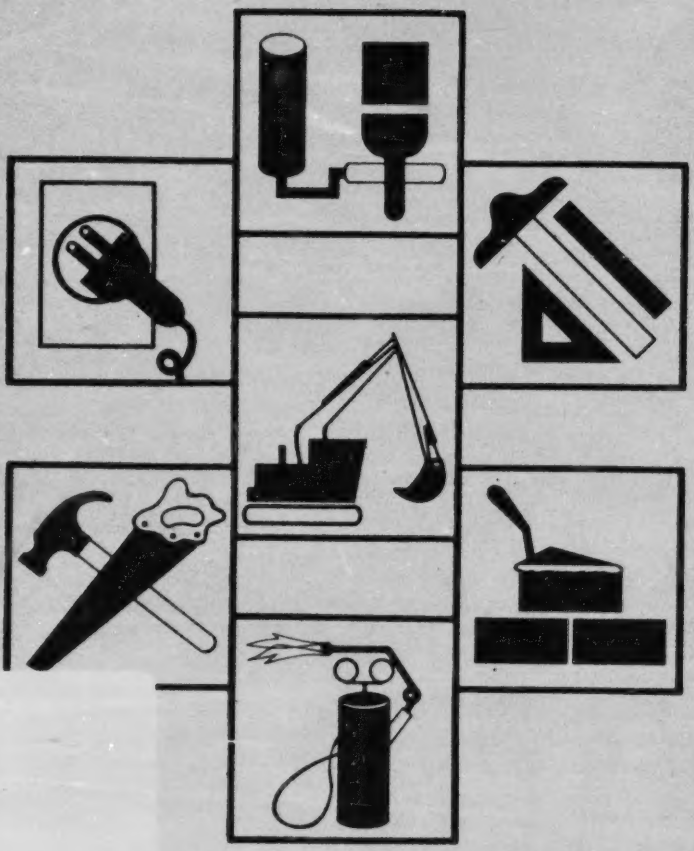

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by

TEXAS EDUCATION AGENCY

AUSTIN, TEXAS

1975

This document is part of the Construction Industry Series and includes several programs for construction occupations at the secondary level.

A complete listing of the titles of this series, each including an instructor's guide and student manual, is as follows:

Exploration Level:

Careers in Construction - Student Manual
Careers in Construction - Instructor's Guide

Occupational Preparation Level:

Wood - Student Manual
Wood - Instructor's Guide
Finishing - Student Manual
Finishing - Instructor's Guide
Engineering, Support and Management Services - Student Manual
Engineering, Support and Management Services - Instructor's Guide
Metal - Student Manual
Metal - Instructor's Guide
Electricity - Student Manual
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ARTICULATION GUIDE

Construction Industry Series

The attempt to organize, communicate and transfer educational experiences in a unified and systematic manner is frustrating to educators.

High schools, community colleges and industry training programs seem to be operating independently of each other. Even within high schools and community colleges, individual departments are insulated from each other.

To relieve some of this frustration, recent efforts have been made to reinforce the channels of communication among and between segments of the educational and training system. This is called *articulation.*

There are two recognized types of articulation which need to be addressed — horizontal and vertical. Horizontal articulation relates to the communication lines among teachers, departments and schools of similar levels within the educational community. Vertical articulation relates to the upward and downward communication lines between educational levels. The primary concern here will be to bridge secondary and post-secondary construction programs and other related educational areas.

HORIZONTAL ARTICULATION - Within secondary-level schools there are areas which have identifiable articulation problems. The greatest single problem area is curriculum development.

Because of the traditional use of program specialists in teaching disciplines, many high schools have departmentalized and clustered teachers around subjects. Most academic teachers utilize commercially produced textbooks to build their subject curriculum. There are very few textbooks today which span several subject areas in an effort to develop a more comprehensive basis for curriculum. History teachers teach history and English teachers teach English, almost in isolation of each other. Of course, the same can be said about all other areas, including occupational and vocational courses. This kind of curricular isolation is far more pronounced in larger high schools than smaller ones.

What is obviously needed is more communications among the independent curricula segments to build a coordinated and cooperative educational system. Vocational instructors frequently do not know exactly what skills their academic counterparts are teaching. These academic skills are as important to the career development of students as the occupational skills learned in a vocational class. Communications skills, math, science and social science classes can contribute significantly to the career aspirations of every student. But to do this and do it effectively, there must be a cooperative effort to develop a checklist of "must know" skills that are provided all students before they leave the secondary school.

A student who can perform complex operations using quadradic equations, but who cannot measure accurately, is not prepared to enter the technical world of work. The "need to know" skills must be taught before the "nice to know" skills.

The formulation of such a checklist of "must know" skills need not threaten any educator. Nor should it be a prolonged and difficult assignment. What may be needed is to have a representative from each department meet with representatives of business, industry and post-secondary institutions. If these meetings are managed properly, using an organized agenda, then the principal objective can be accomplished. The list can then be broken down into the related subject areas and the individual items incorporated as priorities for that curriculum. There will be some overlapping, but this too can be a positive reinforcing exercise.

There are other ways to integrate curriculum. One would be the incorporation of related occupational and vocational vocabulary into the academic subjects. An example of this and how it might be used in a math class, would be to use construction vocabulary in ratio-and-proportion problems rather than the shadows of certain towers or a boat rowing upstream. This is an isolated example and should only be used with students of construction technology. Concrete, shingles, floor covering or steel pipe could easily be substituted in math problems with little effect on the overall exercise. To do well in this case, the teacher should have an idea of what is going on in the vocational shop. This same technique can be used in all occupational and vocational areas to personalize instruction.

In simple terms, horizontal articulation is nothing more than teachers and instructors sitting down as equals, talking and planning together to improve the overall instructional program.

VERTICAL ARTICULATION - Some problems also exist vertically between the secondary and post-secondary schools. Again, the most obvious problem seems to be curriculum. Most post-secondary institutions having construction technology programs start their students at the same level, regardless of the training and experience of these students. Some instructors at both the secondary and post-secondary levels use the calendar as the metering device to produce entry-level students. A two-year program in construction or the building trades is just that — two years.

But what about the student who can and does perform at competency levels higher than other students? Must a student spend a full two years before going into industry? The answer should depend on what the student wants, rather than the number of pages left on a two-year calendar.

Obviously, many instructors are not this rigid. Perhaps one reason why they are more flexible is because they are able to communicate between education levels. If a post-secondary construction program enrolls most of its students from eleven

area high schools, then the training program at the post-secondary institution should become a continuation of the eleven secondary programs. Working together, the instructors of both levels can design a basic modularized curriculum that will indicate a separation between secondary and post-secondary. In some instances, certain secondary students could successfully complete all modules before they graduate. Where post-secondary schools are within commuting distance, these students should be permitted to enter the post-secondary program and continue their training.

Other suggested areas of cooperation between levels are:

- Industrial cooperative training stations
- VICA, DECA, FFA, FHA, OEA, FBLA and other student organizations
- Instructor and counselor exchanges
- Combined workshops and professional growth inservice
- Placement and follow-up services
- Tool and equipment purchases
- Performance standards and credits
- Labor market information
- Construction technology and process improvements information
- Related academic theory
- Curriculum modification
- Maximum usage of facilities
- Adult evening classes
- Technical libraries
- Industry visitation schedules
- Audiovisual libraries
- Advisory committees
- Public relations work
- Professional, technical and trade association memberships

The types of cooperation that are suggested here will not be simple to undertake. There are bound to be a number of restrictive and jurisdictional problems. But if the various administrative groups could work towards the gradual breakdown of traditional barriers, then the flow of constructive communication can and will result. Some of these barriers are physical and may be the easiest to correct. Room assignments might be made in a random fashion, rather than grouping similar classes together. Architects who are planning schools of the future should consider dispersing vocational facilities rather than grouping them together. In many cases, federal and state regulations prevent the use of vocational facilities for other than vocational instruction. These same regulations established the vocational wing or building on a campus which in itself is a move toward instructional isolation. Perhaps future legislation will not be so restrictive.

Most guidance counselor's offices should be moved from the front office area into the instructional area. This would provide the guidance counselor with instructional neighbors, and aid the

articulation process. The stuff that good guidance couselors are made of is information and availability to students. Such a relocation would help the guidance counselor in both areas.

The guidance counselor should provide a valuable articulation service within the school and community. Working with guidance personnel from other secondary and post-secondary schools, the guidance counselor can and should be an informational conduit to the students they serve.

Another area of profound articulation need relates to the changing role of women in the construction industry. No longer can working women be stereotyped exclusively in traditional roles of secretaries and other office positions. They now aspire to be construction professionals, technicians and tradespeople, and training programs at secondary and post-secondary schools must adjust to this evolving trend. Problems of restroom and locker facilities can easily be adjusted. Problems involving attitudes may be more difficult. Therefore, the horizontal and vertical articulation process should include a thorough examination of the education and training system to do away with attitudinal biases which adversely affect any group of students and their chosen career plans.

SUMMARY - Several areas have been covered in this document supporting the concept that greater articulation efforts can increase the effectiveness and efficiency of an educational system. These same efforts can also lead to appreciable cost savings. The pooling of energies, talents, program planning and training hardware, through cooperation, should reduce training costs. Having every school "do their own thing" leads to expensive duplication which may not contribute significantly to training productivity.

Another particularly important part of the articulation effort is the advisory committee. The advisory committee should be responsible for keeping area instructors and counselors informed on conditions in the construction industry. They should also review and give recommendations on the applicability of construction curricula in occupational and vocational education classes. Further, the advisory committee could assist with placement services and cooperative part-time employment for students in the construction programs.

The advisory committee has important responsibilities. In order to meet these responsibilities, committee members should be chosen carefully. It should include representatives of the various trades: Plumbers, pipefitters, sheet metal workers, welders, millwrights, carpenters, electricians, glaziers, sheet rockers, painters, masonry workers, etc. In addition, it should include representatives from management, professional and technical groups: Architects, surveyors, contractors and so forth.

In order to perform their tasks, the advisory committee should meet with construction instructors and counselors at least twice a year, and individual members should visit area classes informally several times a year.

The agenda for meetings with teachers might include curriculum revision, new trade processes, schedules for student visits to construction sites, teacher exchanges with industry, local labor market conditions, and discussions of improvements in co-operative work arrangements and of placement services.

In conclusion, articulation is simply person-to-person communication. It cannot be mandated by administrative edict. Articulation should be, and probably is to some degree, a valuable part of every educational system. But the routines of instructional days, weeks and months, occasionally need to be disrupted to reestablish awareness to the articulation process.

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ABSTRACT: IN ORDER TO REFINE AND IMPROVE THE CAREER ACTIVITIES DEVELOPED IN PART I, A NATIONAL FIELD TEST WAS CONDUCTED FROM NOVEMBER 1974 THROUGH JANUARY 1975. THIS PUBLICATION REPORTS THE RESULTS OF THE FIELD TEST IN WHICH A SAMPLE OF ADULT EDUCATORS CONDUCTED CLASS ACTIVITIES TO EVALUATE THE ACTIVITIES' USEFULNESS FOR THE ADULT EDUCATION CLASSROOM. A SAMPLE OF ADULT EDUCATION PROGRAMS INCLUDING CAREER EDUCATION ACTIVITIES WAS SELECTED FOR THE EVALUATION, INCLUDING PROGRAMS IN BOTH ADULT BASIC EDUCATION AND CONTINUING EDUCATION. SIXTEEN ACTIVITIES, EACH WITH SKILLS, PERFORMANCE OBJECTIVES, MATERIALS, ACTIVITY SUMMARY, TIME REQUIRED, AND POTENTIAL USERS, ARE PRESENTED IN THE FOLLOWING GROUPS: READING RELATED CAREER DEVELOPMENT ACTIVITIES; WRITING RELATED CAREER DEVELOPMENT ACTIVITIES; ORAL COMMUNICATION RELATED CAREER ACTIVITIES; AND CRITICAL THINKING RELATED CAREER ACTIVITIES. (MF)

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EXPLORATIONS

PART I, REVISED

CAREER ACTIVITIES FOR ADULT EDUCATION CLASSES

June 1975

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INTRODUCTION

The Adult Career Education Resources Survey is designed to (a) compile career information resources for adults and (b) provide materials that will encourage adult educators to integrate career education activities into ongoing curricula. An important premise of the Survey effort is that an awareness and orientation to the implications of career education for one's daily life and one's future be developed by adult students. The importance of each adult exploring a variety of realistic career options is also stressed.

Today's adult is becoming aware of needs and demands of our industrialized society. He or she brings to the classroom unique personal values, assets, liabilities, potentials, and attitudes. The adult student may additionally bring experiences in the world of work. Reasons for being in the classroom, be it Adult Basic Education or continuing education, are multiple and varied.

In addressing the varied needs of adults, career education is viable. Moreover, it aligns itself with intricacies of our society and relates to changing job opportunities an individual is likely to experience during his or her worklife. Adult career education focuses strongly on education to help prepare, train, and/or retrain persons throughout their lives. They then do not

find their work skills obsolete and themselves no longer able to contribute meaningfully to their family or self upkeep or to the Nation's economy.

It is estimated that by the end of this decade eight out of ten jobs in the United States will not require a baccalaureate degree.[1/] As a result, it is imperative that educational curricula be reassessed. Curricular activities are needed to provide the adult student with increased understanding of the role of work in our society and the range of careers and jobs available. In this way the adult education community can contribute to effective manpower utilization.

Career education stands out as important in bridging the gap between projected manpower needs and the present adult education process. This thrust brings into the classroom opportunities for career development which relate directly to what the student is learning. According to Kenneth B. Hoyt, "Career education includes career awareness, exploration, decision making, preparation, entry and advancement," and was launched to reflect the needs of our society. "For the past several years people have been demanding that the formal educational system change in ways that will enable students ... to be more successful in finding ... worthwhile, satisfying work ...."[2/]

Many current education programs are becoming more responsive to special needs of their students in relation to the country's total manpower requirements. It is, therefore, fitting that a resource instrument be developed.

[1/] Career Education, U.S. Department of Health, Education, and Welfare, 1971, Washington, D.C. (Pub. #OE 72-39).

[2/] Kenneth B. Hoyt, "Straight Answers on Career Education," Associate Commissioner for Career Education, Washington, D.C. 1975 (Today's Education, N.E.A., Volume 64 #1, p.60).

In this effort, the Survey staff regards the adult education teacher as a resource person in the integration of career education concepts into the adult classroom and community. The adult educator is viewed as assisting in utilization of the Survey's instruments: one who can aid students in seeking answers to career development questions. The teacher is not regarded as a provider of answers; rather, the teacher may provide resources that could be successfully utilized in adult career activities.

Explorations, Part I, Revised

The Survey staff developed Explorations, Part I (Career Activities for Adult Education Classes) during its initial year of activity. It provided a group of exercises for use by adult educators which serve two related objectives: helping adult students become familiar with a spectrum of careers, and permitting introduction of career materials into other learning contexts. During the second year of Survey funding, these activities were field tested. The resultant document is Explorations, Part I, Revised.

Incorporating career awareness into the ongoing adult education curriculum, these exercises have been placed in one of four curriculum areas:

- Reading
- Writing
- Oral communication
- Critical thinking

To further assist the adult education teacher in integrating career activities into ongoing curricula, every activity includes additional characterizations:

- Skills Reinforced by This Activity: refers to curricular subject areas utilized in the performance of the activity;

- Performance Objective: describes in observable, measurable terms behaviors which signify the activity's successful completion;
- Materials Required: includes specific materials necessary to conduct the activity;
- Time Required for Activity: refers to the approximate amount of advance preparation and in-class time required. Actual time is subject to the level of academic development and involvement of each teacher and each class;
- Summary of Activity: briefly describes suggested tasks from initiation to completion;
- Byproducts of Suggested Activity: describes potential results and additional insights which may be experienced by the student through participation in the suggested activity;
- Potential Populations for Utilization: refers to adult populations shown by the field test as able to benefit from and utilize these activities.

Field Testing of EXPLORATIONS, PART I

The Survey staff conducted a national field test of Explorations, Part I from November, 1974 through January, 1975. The purpose of this field test was to elicit specific suggestions for refinement and improvement of each career activity in Explorations, Part I. This publication is the result of that field test effort.

A broad sample of adult educators was asked to conduct career activities in order to ensure usefulness of each activity for the adult education classroom. The educators were requested to make recommendations for improving the activities assigned to them for testing, based on their classroom's results and career education needs of their students.

Survey staff analyzed responses and incorporated needed changes in the activities. Through inclusion of these modifications, Explorations, Part I, Revised is responsive to needs of adult educators and students.

The adult educators participating in the field test were requested to work with the students as resource people in conducting the activities, not as experts in either career education or any particular career field. The adult education teacher's function was to assist students in job and career explorations.

SAMPLE SELECTION

In response to invitations issued in April 1974, 153 Adult Basic Education, continuing education and vocational educational programs were included in Explorations, Part II (State Listing of Adult Career Education Activities) as programs including career education activities in their curricula. This group of programs plus additional ones identified from individual staff contacts and through assistance of Regional HEW Staff Development projects received the three 1974 Survey publications and were asked to complete a School Field Test Interest Indicator. Of those contacted, 31 indicated their willingness to participate in the field test. These programs were contacted personally by telephone to ascertain the number of teachers available, verify educational objectives of the program (Adult Basic Education, continuing education, vocational education), and review demographic characteristics (urban, suburban, rural).

Each program provided adult education teachers who were to conduct three career development activities in their classes. Participating programs designated their students as primarily enrolled in Adult Basic Education, adult continuing education, or adult vocational education. In preliminary discussions with local administrators, it was determined that the exploratory nature of the activities often made them inappropriate for adult vocational students. Generally, such students had already made career choices and were presently developing specific occupational skills. Therefore, vocational education classes were not

included in the final field test. Each participating program was placed, further, in a demographic category: urban, rural, or suburban. The following table indicates the number of participating teachers, the type of adult education program and the demographic characteristics. The teachers were to test three specific activities in their classes; the total number of scheduled test activities is indicated in parentheses in each cell.

ADULT EDUCATION TEACHERS
(Field Test Participants)

Type of Adult Program	Demographic Characteristics		
	Urban	Suburban	Rural
Adult Basic Education	16 (48)*	16 (45)	17 (51)	
Continuing Education	13 (39)	20 (60)	18 (54)	
Other	1 (3)	3 (9)	2 (6)	

( )* total number of activities to be tested in each category.

CONDUCT OF THE FIELD TEST

For those programs participating in the field test, sets of field test materials (one for each teacher) were sent out to each administrator. The Field Test Report Forms which were included in the packets requested teacher comments for each activity on:

- Skills Reinforced by the Activity
- Performance Objective

- Materials
- Time Required for Activity
- Summary of Activity
- By-products of Suggested Activity
- Potential Populations for Utilization

Reactions of the adult education teachers to particular parts of the activity were also collected as well as their suggested improvements. Further, general comments of both instructors and students were solicited for each section of the activity.

The field test effort was monitored very closely to encourage maximum response. Letters were sent and telephone calls were made periodically to project administrators throughout the activity. These helped ensure continued participation and dealt with unanticipated problems. In the final count, 99 Field Test Report Forms were received and used in this revision of Explorations, Part I in the following categories. (The number in parentheses is the percentage of returned forms from the original field test commitments.)

NUMBER OF ACTIVITIES COMPLETED

Type of Adult Program	Demographic Characteristics		
	Urban	Suburban	Rural
Adult Basic Education	9 (18.6%)	16 (35.6%)	21 (41.1%)
Continuing Education	14 (35.9%)	16 (26.7%)	20 (37.0%)
Other	0 (0%)	1 (11.1%)	2 (33.3%)

Role of the Adult Education Teacher

The adult education teacher's role in the successful utilization of these refined activities is twofold. First, the teacher's role is that of resource person, not expert, in career materials or specific occupational areas. The teacher, serving as a facilitator, is a link between the world of career information and individual student needs. Each suggested activity emphasizes student participation, encourages development of student self-direction, and provides opportunity for experiencing the excitement of exploration and discovery.

The second function of the teacher is that of selector in reviewing recommended activities. Although adult target groups which may benefit from an activity are suggested, its usefulness for other groups is not precluded. Survey staff make no judgement ments for the adult teacher. Each teacher is invited to review these activities in terms of the needs of his or her students. These are activity guides, explorations into career education, not teaching edicts. Teachers are urged to review and utilize what is relevant in their particular classes. It is hoped that activities suggested here will be adapted to the class situation, not merely adopted by the teacher. If these activities are to be helpful to the adult student, they must be meaningful to his or her particular requirements. In selecting instructional material, the teacher is the judge of what may be most meaningful to his or her adult students.

Companion Publications: The Resources Volumes

Explorations, Part I, Revised is one of two publications of the Adult Career Education Resources Survey developed during its second year of operation. Of particular relevance to readers and users of Explorations, Part I, Revised is the Survey's compendium of adult career information materials, Resources: Recommendations for Adult Career Resources, Supplement. This

supplement was developed as a result of the Survey's publication of Resources, Recommendations for Adult Career Resources during its initial year of activity. Both publications contain useful references to career materials. Both volumes include abstracts of career materials from a variety of media. Materials listed were reviewed for suitability, not only in terms of use by adults, but also in presenting quality career information. Reading levels, of particular importance to Adult Basic Education teachers, have been included for each piece of written career material. The Supplement provides additional career information resources, with increased proportions of materials which are:

- Produced in audio-visual media formats;
- Written at reading comprehension levels better suited to adults with lower levels of reading skills;
- Addressed to the needs of women and minorities.

Focus has also been placed on inexpensive or free materials. Each entry in the supplement is similar to the abstract included below and is catalogued according to major occupational areas.

TRANSPORTATION

16.210

TITLE: Local Bus Drivers

DATE: 1974 PAGES: 4
PRICE: $.55 READING LEVEL: II

SOURCE: Science Research Associates, Inc.
259 East Erie Street
Chicago, Illinois 60611

Lucid presentation of qualifications, duties, and working conditions of a bus driver. History of occupation, entrance methods, means of promotion, salary, unions, and employment outlook included. Mentions employment possibilities for women.

READING RELATED
CAREER DEVELOPMENT ACTIVITIES

1 USING PRINTED
CAREER INFORMATION

2 RELATING CAREERS
TO CURRENT EVENTS

3 INTER-CITY
JOB COMPARISON

READING RELATED CAREER DEVELOPMENT ACTIVITIES

Reading is a basic life-coping skill. Information acquired through reading contributes to self-development. It helps each person to carry out his or her life responsibilities, as an individual and as a member of society. Reading skills serve as one tool for acquiring the curriculum that most educational institutions offer. Reading skills are necessary for the student to continue education and for self-actualization throughout life, both in and out of school.

Significance is derived from the printed word only when the meaning is unlocked. Drills in phonics and phonemes, which form the basis of introductory reading curriculum at all levels, is usually supplemented by activities which reinforce and give practice in these skills. With this in mind, the Adult Career Education Resources Survey has developed the following three activities which serve to reinforce reading skills, in addition to providing basic career development information.

USING PRINTED CAREER INFORMATION provides the adult student with a direct opportunity to exercise reading skills. Students are asked to read for specific information in career materials, verbalize the acquired information, and formulate questions applicable to other career literature.

RELATING CAREERS TO CURRENT EVENTS instructs students to analyze, through their reading, current economic or social problems and to take advantage of the interest aroused to examine careers associated with industries involved with the problem. Inherent in this exercise is the adult's ability to read analytically and generalize what is learned to other areas.

INTER-CITY JOB COMPARISON directs adult students in the process of critically reading for information and in analyzing related learning facts. In this exercise, students are to visit their local libraries to utilize out-of-town newspapers. The students then analyze the career opportunities about which they read.

1 USING PRINTED CAREER INFORMATION

SKILLS REINFORCED BY THIS ACTIVITY

Reading

Writing

Oral Communication

Social Studies Understandings

Library/Research Capabilities

PERFORMANCE OBJECTIVE

Students read for specific career information, verbalize questions relevant to development of career priorities and respond in writing to the questions raised.

MATERIALS

* Pamphlets about specific careers pre-selected by the teacher to provide a general overview of occupations. (The teacher may wish to obtain materials reviewed in Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, or other locally available resource listings of career information);

* Mimeographed question sheet (based upon student-raised questions after initiating this activity).

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: two to four hours;

* Class Time: two sessions;

(Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

Prior to the activity, the teacher places selected career materials on a table near the door. Students are encouraged to explore materials as they enter. After sufficient browsing time, the teacher opens class discussion with such questions as:

"What are these booklets about?"
"Do you want a particular job?"
"What kind of job do you want in two years?"
"Why should we explore new information on careers?"
"Do you work solely to earn money?"

The teacher may want to assist students in differentiating between the concept of work solely as a means to supply food and shelter and work as an aspect of self-fulfillment. The teacher should keep in mind, however, the practical needs of the students in relation to job discussions. After some discussion on concepts such as congruence of a particular job with one's values, attitudes, aptitudes and skills, and financial requirements, the teacher focuses discussion on student-felt needs and questions concerning what to look for in a career.

The teacher serves as a discussion organizer to keep questions in an exploratory vein. Discussion is not directed at one particular career, but rather at the concept of a career versus a job. Each question raised by students is listed by the teacher on the chalk board.

Later, the teacher transfers the questions to a stencil. In composing the stencil, enough space is left between questions for students to write in answers and fill in the titles of related career pieces. Two questions should also be added by the teacher at the end of the sheet:

"Does this tell you everything you want to know about this career?"

"Where can you go for further information?"

When sheets with student-raised questions have been distributed to the class, 30-40 minutes should be allotted for completion. This would most likely happen at the next class meeting. When completed, the exercise should be drawn together with an overall discussion of individual insights.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Exposure to career information and trends about which student is unaware;
* Increased exposure to careers about which student is aware;
* Development of skill in seeking out and arranging priorities;
* Practice in reading for specific information.

POTENTIAL POPULATIONS FOR UTILIZATION

* ABE students;
* Adult students located in urban, suburban, or rural areas;
* Adult students of varied ages, socio-economic, racial and ethnic background;
* Women students entering or reentering the workforce.

2 RELATING CAREERS TO CURRENT EVENTS

SKILLS REINFORCED BY THIS ACTIVITY

Reading

Writing

Oral Communication

Current Events

Library/Research Capabilities

Aural Interpretations

PERFORMANCE OBJECTIVE

Students relate basic elements of a problem in current events to its appropriate career field in an analytic report.

MATERIALS

* Newspapers and news magazines. (The teacher may want to include newspapers and magazines which reflect the ethnic and racial composition of the class. One source reference for identifying suitable newspapers is Ayer's Directory of Publications, Published by Ayer's Press);

* Career information in print and non-print media. (The teacher may wish to obtain materials reviewed and abstracted in Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, containing both print and non-print resources, or from other locally available resource listings of career information);

* Television programs (i.e., "White Papers," special news stories).

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: less than two hours;

* Class Time: two sessions;

(Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

This exercise can be used with current governmental, economic, social or community problems which have been reported in newspapers, magazines, or on television. For example, if a class is discussing the rising cost of food, students may be assigned the task of exploring the problem by examining jobs and careers in the food industry. They may list jobs available in the food industry at all levels of production. Each student then selects one of the industry's careers (ranging, in this instance, from cattle ranchhand to grocery story clerk) and conducts research pertinent to both the problem and the career. These findings may then be reported in written or, if preferred, oral form. Included in such a report is the student's analysis of the problem and recommendations for improving the situation. Students are encouraged to take a position on the problems and defend that position.

The same procedure may be utilized for discussing the trucking industry, the automobile industry, or the steel industry. Conservation and ecology problems likewise offer many possibilities.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Awareness of current problems;
* Awareness of mass media;
* Relationship of economic and social events to the world of careers;
* Emphasis on critical thinking.

POTENTIAL POPULATIONS FOR UTILIZATION

* Adult evening high school students;

* Adult students located in urban, suburban, or rural areas;

* Adult students of younger age, with varied socio-economic, racial and ethnic backgrounds;

* Women students entering or reentering the workforce.

3 INTER-CITY JOB COMPARISON

SKILLS REINFORCED BY THIS ACTIVITY

Reading

Geography

Research

Economic Understanding

PERFORMANCE OBJECTIVE

Through analysis of newspaper classified sections, advertisements, recreation, entertainment notices, weather reports, etc., students present oral reports on career opportunities in various cities.

MATERIALS

* School letterhead stationery (newspaper publishers often provide complimentary issues for use in schools if requests are sent on the letterhead of the school);
* Stamps and envelopes;
* Newspapers from selected cities.

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: two to four hours;
* Class Time: two sessions;

  (This is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

Following a discussion of local job opportunities, students may wish to place their findings in perspective by comparing local job situations with those in other parts of the

country. Students may work individually or in groups. The local library is one possible source for the newspapers of communities in other parts of the State and/or country. If the newspapers cannot be checked out, then the review may be conducted in the library. Ideally, newspapers selected for review should include cities of disparate sizes, resources and geographic make up.

Each student can select a particular career and trace the opportunities for pursuing this career in each of the cities represented by the newspapers. Career analysis efforts could include a comparison of classified advertisements.

Students may also be encouraged to compare the quality of life in different areas as reflected in newspaper articles and their physical locations. The teacher may want to observe that classified ads do not reflect the entire spectrum of job opportunities available in a particular location. Final reports are submitted in essay form and shared with the class.

Note: This activity could have particular relevance for foreign adult students such as those who are Spanish speaking. Newspapers in Spanish and other languages could be included for those students.

BYPRODUCTS OF SUGGESTED ACTIVITIES

* Expanded career awareness;
* Practice in library use or research;
* Development of analytical skills.

POTENTIAL POPULATIONS FOR UTILIZATION

* ABE students;
* GED students;
* Adult students located in urban, suburban, or rural areas;

* Adult students of varied ages, socio-economic, racial and ethnic backgrounds;

* Women students entering or reentering the workforce.

WRITING RELATED
CAREER DEVELOPMENT ACTIVITIES

4 WRITING
FOR INFORMATION

5 A WORKDAY
IN THE LIFE OF ...

WRITING RELATED CAREER DEVELOPMENT ACTIVITIES

Skill in writing is an integral part of all language arts and curricula. Writing curriculum stems from the traditional foundations of spelling, grammar, handwriting, and composition. Individual and collective proficiency in these areas provide the structure which allows individuals to communicate thoughts, values and knowledge with others.

For adult students deficient in writing skills, the goal of the curriculum in writing is to improve the student's ability to demonstrate and express clearly his or her thoughts. It is important, therefore, that the student's choice of language not detract from what is being stated through excessive use of peculiar speech idiom or phrases. Another objective of curricula concerned with writing skills is to strongly focus the reader's attention on the value of what is being communicated.

Skill in written expression is best strengthened by practice. The following two career-related activities are designed to reinforce writing skills in adult education.

WRITING FOR INFORMATION provides adult students with practical experience in using their writing skills. In sending for career materials, students compose an appropriate business letter. They can gain practice in writing to business establishments and learn how to request materials.

WORKDAY IN THE LIFE OF ... is designed to promote creative writing talents. In this exercise adult students are asked to develop a character engaged in an unfamiliar career area. Students should draw on their own resources and describe their character's work life as they imagine it. Once completed, students research the occupational fields on which they have written. They can then compare the realities of the career with their preconceived images.

4 WRITING FOR INFORMATION

SKILLS REINFORCED BY THIS ACTIVITY

Writing Business Letters

Research Skills

PERFORMANCE OBJECTIVE

Each student composes suitable business letters requesting career materials.

MATERIALS

* Career information (The teacher may wish to obtain materials reviewed and abstracted in Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, or other locally available resource listings of career information);
* Stationery, stamps and envelopes.

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: under two hours;
* Class Time: one session;

(Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

As the students enter class, each is encouraged to look at career materials, select one career pamphlet in which he or she is interested, and review it as the class is getting settled.

When class begins, the teacher introduces a discussion on methods of obtaining these pamphlets. Such discussion might include by what means other sources may be located and tapped for career information.

After reviewing correct business letter form, each student is then encouraged to draft a letter suitable for requesting career materials. Students may either request a copy of the pamphlets already examined or request literature suggested as further sources of information. The following is an example of a correct business letter form.

BUSINESS LETTER FORMAT

Omit if using letterhead { Return address
City, State, Zip
Date

Addressee, Title
Street Address
City, State, Zip Code

Salutation:

Body: Introduction and purpose of letter.

Complimentary closing,
(Full Name Signed)
Full Name Typed
(if letter is typed)

During this exercise, the teacher can review with the class various forms of business letters, explaining the rationale for each form and each component. The teacher discusses with students the necessity of producing a draft of the letter and notes that this tool is used by even the most experienced writers to obtain the exact wording required.

Once completed, the final draft should be typed or written by the students. The students may now look forward to receiving their own career materials.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Exposure to career information;
* Letter writing experience;
* Practice in editing;
* Dictionary skills.

POTENTIAL POPULATIONS FOR UTILIZATION

* ABE students;
* GED students;
* Advanced ESL (English as a Second Language) students;
* Adult students located in urban, suburban, or rural areas;
* Adult business occupation students;
* Adult students of varied ages, socio-economic, racial and ethnic backgrounds;
* Women students reentering workforce.

5 A WORKDAY IN THE LIFE OF ...

SKILLS REINFORCED BY THIS ACTIVITY

Creative Writing

Reading

Research Capabilities

PERFORMANCE OBJECTIVE

Students write a short essay (suggestion: two pages) on a career they have not researched. They relate their present understandings of the career, then compare them with information found in career materials available to the class.

MATERIALS

* Career information on unusual careers such as Your Future in Exotic Occupations, Dora R. Evers and S. Norman Feingold, (Richards Rosen Press, Inc., 29 East 21st Street, New York, New York 10010, 1972, $4.80);

* Career information (The teacher may wish to obtain materials reviewed and abstracted in Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, or other locally available resource listings of career information);

* Hat or box.

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: two to four hours;

* Class Time: one class session;

(Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITIES

A list of unusual careers for which descriptive material has been obtained should be distributed to the students. Each student selects from the list one career that he or she is curious about. Teacher should encourage that some range of career selection is exercised in this activity.

Students are then assigned to write, from their present understandings, a descriptive essay entitled "Workday in the Life of ..." After choosing the name of a character, the student traces and lists daily activities and work responsibilities of this person for one complete day. Since the career chosen will sometimes be outside the student's daily life (i.e., sandhog, dollmaker, golf course patroller, auctioneer, diver, beekeeper, etc.), the essay may be fabricated in parts or composed of popular misconceptions or stereotypes.

When the paper is completed, the student locates the career brief or book which describes this occupational area. Students should then compare printed information with what has been written in their papers. Discrepancies should be noted in the margins. Students may then discuss career areas studied with group and review new learnings including the reality or non-reality of stereotypes in a job situation.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Awareness of career options;
* Practice in dealing with stereotypes;
* Practice in researching opinions with facts.

POTENTIAL POPULATIONS FOR UTILIZATION

* ABE students;
* GED students;

* Adult students located in urban, suburban or rural areas;

* Adult students of varied ages, socio-economic, racial, and ethnic backgrounds;

* Women students reentering workforce.

ORAL COMMUNICATION RELATED
CAREER DEVELOPMENT ACTIVITIES

6 DEMONSTRATION SPEECH

7 CAREER NIGHT

8 MOCK EMPLOYMENT AGENCY

9 WORKER FOR A DAY

10 INVITING A RESOURCE PERSON TO CLASS

ORAL COMMUNICATION RELATED CAREER ACTIVITIES

Speaking is an expressive art which mirrors thoughts, values, and ideas of the speaker. Speech is intended to convey a message from one person to others. Effective oral communication presents the speaker's thoughts in a manner accurately reflecting the speaker's intent.

In teaching students effective skills in oral communication, one goal of the curriculum is minimizing distracting elements in speech. The listener can then focus on what is being said, rather than the manner of presentation.

Improvement in oral communication is accomplished with continual practice. Ease of presentation often accompanies continued practice, which then leads to improved speaking skills. The Adult Career Education Resources Survey has produced a series of career education activities which emphasize oral communication skills.

DEMONSTRATION SPEECH suggests that students research a given career field, interview a worker in that occupation, and orally relate to the class an acquired job-related skill. Interviewing and presenting a speech are skills this activity reinforces.

CAREER NIGHT suggests at least five representatives of specific career fields be invited to the class for student-initiated interviews. While students gain actual knowledge of career opportunities in their geographical area, they also develop their interrogatory oral skills.

MOCK EMPLOYMENT AGENCY illustrates a career planning process while developing oral communication skills. After a careful planning effort employment agency workers are interviewed for procedural information. It is suggested that the class organize and operate their own mock agency. Biographical and interest inventories are utilized to lend authenticity to the activity. Interviewing and application techniques are integral parts of this activity.

WORKER FOR A DAY involves students in active career observation and participation. In conjunction with the study of occupations, students are urged to accompany a worker for a day and to become involved if possible in the duties of the job. Preparation and participation in this activity involves a great many oral communications. These skills may enable the student to gain confidence in expressing himself and in eliciting useful information.

INVITING A RESOURCE PERSON TO CLASS is a group subject. The class chooses and invites a resource person from the community to speak on his or her career field. Oral skills developed by this activity include formulation of pertinent questions, expression of opinions, and ability to lead and participate in a discussion.

6 DEMONSTRATION SPEECH

SKILLS REINFORCED BY THIS ACTIVITY

Oral Community/Group Discussion

Reading

PERFORMANCE OBJECTIVE

After reading career materials concerned with a specific occupation, students (1) individually interview a worker in that occupation, (2) learn one of the skills essential to that occupation, and (3) demonstrate or describe the skill to the class in an oral report.

MATERIALS

* Career information (The teacher may wish to obtain materials reviewed and abstracted in Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, or other locally available resource listings of career information).

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: less than two hours;
* Class Time: one to two sessions, depending on size of class;

  (Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

Students select a piece of career literature written about a particular career field. One week is given to locate a worker in the described career field and interview him or her with regard to specific skills used on the job. A minor job-related skill is

learned from that person. Examples of such skills might be taking a pulse, calculating with a slide-rule, taking window-measurements etc. As preparation for the task, the class compiles a list of ways to locate an appropriate person to interview. They also discuss how to set up and conduct an interview.

When class reconvenes, each student has the opportunity to present the learned skill in the form of a demonstration. Students also describe their reactions to the career.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Specific job skill required;
* Student self-reliance improved in coping with new situations.

POTENTIAL POPULATIONS FOR UTILIZATION

* ABE students;
* Adult evening high school students;
* Adult students located in urban, suburban, or rural areas;
* Adult students of varied ages, socio-economic, racial and ethnic backgrounds;
* Women students entering or reentering the workforce.

7 CAREER NIGHT

SKILLS REINFORCED BY THIS ACTIVITY

Oral Communication/Group Discussion

Interviewing Skills

Reading

PERFORMANCE OBJECTIVE

Students interview at least five career representatives who visit the class to inform them of various career fields.

MATERIALS

* Career information (The teacher may wish to obtain materials reviewed and abstracted in Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, or other locally available resource listings of career information).
* 5-10 card tables (brought by students or provided by school);
* 5-10 straight chairs from library or cafeteria;
* Refreshments (contributed by students);
* Mimeographed question sheet, as developed from student questions.

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: four to six hours;
* Class Time: one session;

  (Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

Planning begins four to six weeks prior to the scheduled Career Night experience. As a class, students decide on 5-10

career occupations about which they would like information. In a science class, for example, careers should be science related, such as x-ray technician, respiratory technician, cancer researcher, metallurgist, biologist, dental assistant, etc. A math class selects careers that are math oriented, such as bookkeeper, bank teller, accountant, IRS representative, actuary, etc. A government class selects related careers, such as Head-Start aide, government service worker, enlisted personnel or officers from Armed Services, city official, senior citizens worker, etc. Speakers should represent a variety of racial/ethnic groups as well as a variety of career fields.

Students form committees based upon chosen careers. Then they invite representatives from the selected fields to visit the class. The class as a whole formulates questions to ask of the invited career representatives. The teacher reproduces the questions for distribution to the students.

On the designated evening, each representative is assigned an individual chair and table. Each student should interview at least five of the career representatives about their work. As a result, students should be able to supply answers to the questions on the sheet which the teacher has distributed.

Students should be free to wander from table to table and seek whatever information they wish. Refreshments may be served toward the end of the evening.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Community spirit encouraged;
* Career knowledge expanded;
* Social skills such as extending invitations and serving refreshments emphasized.

POTENTIAL POPULATIONS FOR UTILIZATION

* Adult evening high school students;
* Adult students located in urban or suburban areas;
* Adult students of varied ages, socio-economic, racial, and ethnic backgrounds;
* Women students entering or reentering workforce.

8 MOCK EMPLOYMENT AGENCY

SKILLS REINFORCED BY THIS ACTIVITY

Oral Communication/Group Cooperation
Listening
Reading

PERFORMANCE OBJECTIVE

Students operate a simulated employment agency and utilize its services.

MATERIALS

* Career information (The teacher may wish to obtain materials reviewed and abstracted in Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, or other locally available resource listings of career information);
* Chairs, tables;
* Interest inventory such as one of the forms of the Kuder Preference Record or Thurstone Interest Schedule;
* Job application forms (sample included in activity).

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: four hours;
* Class Time: three class sessions;

  (Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

Students may illustrate one facet of the career planning process by establishing a mock employment agency.

Students should coordinate their planning efforts two or three weeks prior to the anticipated activity. Several local

employment agency workers representing both private and government-operated institutions may be contacted and interviewed by the students.

Note: Judgement should be exercised in selection of employment agency workers to insure that they are representatives of their profession.

Classes pool their members' thoughts and suggestions. The class and teacher construct a system of operation which incorporates the most effective methods of utilizing services of an employment agency. The class also practices using application forms to be used in eliciting background information from agency applicants. The teacher should carefully review the importance of properly completing job application forms. One-to-two hours could be spent in class discussion and completing practice application forms. The teacher may also want to lead a class discussion on appropriate behavior during a job interview. Applicant interest, responsiveness and self-confidence may be stressed. A sample application blank is provided at the close of the activity.

During the interim period between planning and operation, an interest inventory may be administered by the guidance department in cooperation with the teacher. The teacher or counselor should carefully explain the purpose of the test, define "interests," and note differences between interests and abilities.

On the evening of the planned event, the mock agency is set up in a prominent area of the room. Students who serve as "employment counselors" sit behind a table containing representative career materials. Students simulating job applicants approach counselors with the results of their interest inventory. They should be prepared to fill out the job application forms. Counselors help steer applicants into appropriate career choices.

After a time, counselors and applicants may exchange roles. Students review the quality of counseling they received as a follow-up activity.

Variation: Students may wish to designate certain tables and counselors specifically for handling special needs, such as counseling for women, minority groups, handicapped, professionals, non-professionals, etc.

Variation: Students organize three-person teams including interviewer, applicant and observer. This method gives each student immediate feedback and encourages continuous involvement and participation. Listening and speaking skills are reinforced through team role.

Note: This activity could also be adapted to students applying to a community college, college or other continuing education program.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Career knowledge reinforced;
* Self reliance in development of personal interaction skills;
* Personal flexibility developed in role playing.

POTENTIAL POPULATIONS FOR UTILIZATION

* ABE students;
* Adult students located in urban, suburban, or rural areas;
* Adult students of varied ages, socio-economic, racial, and ethnic backgrounds;
* Women students entering or reentering the workforce.

APPLICATION FOR EMPLOYMENT

PERSONAL INFORMATION

Date _____ Social Security Number _____

Name _____ Last _____ First _____ Middle _____ Age _____ Sex _____

Present Address _____ Street _____ City _____ State _____ Zip _____

Permanent Address _____ Street _____ City _____ State _____ Zip _____

Phone Number _____ Own Home _____ Rent _____ Board _____

Date of Birth _____ Height _____ Weight _____ Color of Hair _____ Color of Eyes _____

Married _____ Single _____ Widowed _____ Divorced _____ Separated _____

Number of Children _____ Dependents Other Than Wife or Children _____ Citizen of U. S. A. Yes O No O

If Related to Anyone in Our Employ, State Name and Department _____ Referred By _____

Last First Middle

EMPLOYMENT DESIRED

Position _____ Date You Can Start _____ Salary Desired _____

Are You Employed Now? _____ If So May We Inquire of Your Present Employer _____

Ever Applied to this Company Before? _____ Where _____ When _____

EDUCATION	Name and Location of School	Years Attended	Date Graduated	Subjects Studied
Grammar School				
High School				
College				
Trade, Business or Correspondence School				

Subjects of Special Study or Research Work _____

What Foreign Languages Do You Speak Fluently? _____ Read _____ Write _____

Armed Forces _____ Rank _____ Present Membership in National Guard or Reserves _____

Activities Other Than Religious (Civic, Athletic, Fraternal, etc.) _____

EXCLUDE ORGANIZATIONS, THE NAME OR CHARACTER OF WHICH INDICATES THE RACE, CREED, COLOR OR NATIONAL ORIGIN OF ITS MEMBERS.

FORMER EMPLOYERS (List Below Last Four Employers, Starting With Last One First)

Date Month and Year	Name and Address of Employer	Salary	Position	Reason for Leaving
From				
To				
From				
To				
From				
To				
From				
To				

REFERENCES: Give Below the Names of Three Persons Not Related To You, Whom You Have Known At Least One Year

	Name	Address	Business	Years Acquainted
1				
2				
3				

PHYSICAL RECORD:

List Any Physical Defects

Were You Ever Injured? Give Details

Have You Any Defects In Hearing? In Vision? In Speech?

In Case of Emergency Notify

Name Address Phone No.

I authorize investigation of all statements contained in this application. I understand that misrepresentation or omission of facts called for is cause for dismissal. Further, I understand and agree that my employment is for no definite period and may, regardless of the date of payment of my wages and salary, be terminated at any time without any previous notice.

Date Signature

DO NOT WRITE BELOW THIS LINE

Interviewed By Date

REMARKS:

Neatness		Character	
Personality		Ability	

Hired For Dept. Position Will Report Salary Wages

Approved: 1. 2. 3.

Employment Manager Dept. Head General Manager

9 WORKER FOR A DAY

SKILLS REINFORCED BY THIS ACTIVITY

Oral Communication

Writing

PERFORMANCE OBJECTIVE

Students observe a public service job for a day and then compare their experiences with their anticipations.

Note: For some students this activity may not be feasible due to time, job, or family constraints.

MATERIALS

* Career information on locally available career opportunities (The teacher may wish to obtain materials reviewed and abstracted in Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, or other locally available resource listings of career information).

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: two to four hours;
* Class Time: three sessions;

  (Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

A study of locally available career opportunities is made. Capitalizing on student interest, teachers arrange with representatives of selected career fields for students to observe them on the job. Local government agencies, such as police, municipal government, etc., often welcome such visits.

Students decide which occupation they would like to observe and then write a letter of request to an appropriate person. The teacher acts as a resource person in guiding students to an appropriate individual. (See guiding activity #4 for information on business letter forms.) Before the visit takes place, students decide as a group as to what will most enrich their learning experience. After the observation day, students are encouraged to share their experiences and feelings with the class. As a culminating activity, each student writes a short essay comparing his or her observations on the job with his expectations based solely on reading the career materials.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Self-reliance in social/public situations;
* Critical thinking developed;
* Better understanding of job skills and components;
* Telephone skills;
* Practice in letter writing;
* Specific career knowledge gained.

POTENTIAL POPULATIONS FOR UTILIZATION

* Advanced ABE students;
* Adult students located in urban or suburban areas;
* Adult students of varied ages, socio-economic, racial, and ethnic backgrounds;
* Women students entering or reentering the workforce.

10 INVITING A RESOURCE PERSON TO CLASS

SKILLS REINFORCED BY THIS ACTIVITY

Oral Communication
Writing
Listening

PERFORMANCE OBJECTIVE

Students obtain career information by inviting to the class a resource person from the community. Possible sources: local hospitals, Red Cross, American Legion, Veterans of Foreign Wars, League of Women Voters, American Association of University Women, B'nai B'rith, Kiwanis, Rotary, Lions, other local service organizations or local counseling services.

MATERIALS

* School letterhead stationery;
* Stamps, envelopes.

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: two to four hours;
* Class Time: two to three sessions;

  (Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

The teacher and class decide together on a community resource person who could broaden the class' knowledge of career opportunities in the local community.

Note: Teachers should exercise care in guiding the class' selection of speakers. Speakers may influence student self-concepts, role-models, etc.

A student makes a preliminary telephone contact with the recommended speaker. He or she learns whether that person is available for a class meeting. The class then issues a written invitation to the proposed speaker. Following the speaker's acceptance of the invitation, the group prepares and refines a list of topics that they wish the speaker to cover during the seminar session. (Correct business letter forms can be reviewed in guiding activity #4.) The class discusses whether a committee of students should meet in advance with the speaker, to indicate what the class is like, its goals, and what they would like to learn from the speaker. On the night of the seminar, one student acts as host for the session. The host is responsible for meeting the resource person and introducing him or her to the class. Both students and speaker should be prepared for a lively interchange of ideas.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Social behaviors emphasized;
* Practice in letter writing;
* Linkage between the classroom study of career and local resources established.

POTENTIAL POPULATIONS FOR UTILIZATION

* ABE students;
* Pre-GED students;
* Adult students located in urban or suburban areas;
* Adult students of varied ages, socio-economic, racial, and ethnic background;
* Women students entering or reentering the workforce.

CRITICAL THINKING RELATED
CAREER ACTIVITIES

11 REVIEWING THE CAREER MATERIAL

12 COMPARING MEDIA

13 WHAT DO THE WANT ADS SAY

14 PERSONALITY FACTORS IN WORK CHOICES

15 CAREER DISPLAY

16 CAREER FILE

CRITICAL THINKING RELATED CAREER DEVELOPMENT ACTIVITIES

Awareness of critical thinking skills is a relatively recent addition to the adult education curriculum. Traditionally the curriculum concentrated on learning of fundamental subject areas. Recent philosophy in adult education, however, has evolved from largely mastering the "Three R's" to an inclusion of concepts of relevance to the students' real world and development of coping skills.

Education should help students learn how to arrive at their own value judgements and make decisions. Practice in critical thinking skills encourages students to consider carefully arguments they read and hear, to react to these ideas, and to formulate decisions as to their appropriateness or authenticity.

Critical thinking is a vital part of adult education. Skills which help the student to analyze and arrive at decisions are tools which will help the individual in many endeavors. Survey staff emphasize this curriculum skill through formulation of six career development activities which reinforce this skill.

REVIEWING THE CAREER MATERIALS is an activity which focuses on developing evaluative skills. Students utilize an evaluation instrument designed to evaluate career material in all media.

COMPARING MEDIA requires students to analyze and compare methods of presenting career information. Advantages and disadvantages of each medium are considered before the student arrives at a decision regarding the effectiveness of that medium.

WHAT DO THE WANT ADS SAY asks students to locate three jobs in the newspaper classified sections for which they qualify and then explore where these jobs lead. Embodied in this task is the determination of how closely the job as represented compares with the job as it actually is.

PERSONALITY FACTORS IN WORK CHOICES has students view a career filmstrip. Comments workers made in the film about job suitability are then evaluated. Students also determine relationships between a given job and its personality requirements.

CAREER DISPLAY instructs students to create a relevant and informative career-related display. Creative artwork is combined with an analysis of growth patterns, locations of job opportunities, and information retrieved from interviews and research.

CAREER FILE requires students to develop a system suitable for filing career information literature. The developed system is a result of analyzing existing forms and eclectically utilizing features which are most relevant to class needs.

11 REVIEWING THE CAREER MATERIAL

SKILLS REINFORCED BY THIS ACTIVITY

Critical Thinking
Reading

PERFORMANCE OBJECTIVES

Students critique several items of career information (print and audio/visual) with the help of a review instrument to determine whether career material is appropriate for use. (The number of career pieces to be reviewed should realistically reflect capabilities of the individual student.)

MATERIALS

* Career information (The teacher may wish to obtain materials reviewed and abstracted in Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resource Survey, or other locally available resource listings of career information.)
* Reproduced review forms.

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: two to four hours;
* Class Time: two to three sessions;

  (Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

The teacher begins by leading a discussion on the quality of career literature available, e.g., what specific information are you looking for when you read about a career or watch a career film? Students are encouraged to list on the chalk board

both positive and negative points they have encountered in their readings.

These features become a springboard for the teacher to help the class create a means of evaluating career information objectively. The teacher may at this point wish to introduce the review instrument shown at the end of this activity as a guideline for discussion.

Students and teacher may wish to utilize the included form or modify it to reflect their own discussion outcomes. Once the review instrument has been agreed upon, the teacher reproduces copies and makes certain they are easily accessible to the students. Students should be encouraged to evaluate career materials at their leisure (with assistance from the teacher if audio/visual equipment is required). Several students may wish to review the same piece (separately) to increase reliability of the review. The recommended materials should be kept highly visible in the room so that career information of high quality will be singled out for repeated use.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Evaluation skills developed;
* Student made responsible for his own learning.

POTENTIAL POPULATIONS FOR UTILIZATON

* GED students;
* Advanced adult students located in urban, suburban, or rural areas;
* Advanced adult students of varied socio-economic, racial, and ethnic backgrounds;
* Women students reentering the workforce.

ADULT CAREER EDUCATION REVIEW FORM

Print and Audiovisual Materials

Subject Area: _____

Reviewer: _____

Date Reviewed: _____

Appropriate for Adults: Yes/No

Media: _____ print

_____ audiovisual (specify)

_____

_____ Recommended as of Superior Quality

_____ Highly Recommended

_____ Recommended

_____ Recommended with Reservation

_____ Not Recommended

Title: _____ Author: _____

Source: _____

_____

Print: Year of Publication: _____; No. of Pages: _____; Price: _____.

Audiovisual: Year of Production: _____; Running Time: _____; Price: _____.

A. Content	Excellent	Good	Fair	Poor	Unacceptable
1. Definition of Occupation					
2. Work Duties Given					
3. Work Settings Shown					
4. Educational Qualifications Required					
5. Credentials Required (licenses, union, etc.)					
6. Personal Qualifications					
a. physical demands					
b. emotional demands					
7. How to Enter the Job					
8. Advancement Possibilities					
9. Employment Outlook (supply and demand)					

	Excellent	Good	Fair	Poor	Unacceptable
10. Potential Personal Rewards (i.e., salary, use of creative abilities, decision-making opportunities)					
11. Advantages and Disadvantages of Career Area					
Add Up Number of Checks in Each Column					
Subtotal Inflated (Multiply Number of Checks by Respective Weights)	x5___	x4___	x3___	x2___	x1___

Sum of Content Points (Box A) [ ]

B. Style and Format	Excellent	Good	Fair	Poor	Unacceptable
1. Style: Information is clear, and presented in an appealing manner					
2. Quality of Publication (or Audiovisual piece), i.e., readable, type, enhancing pictures, (or for a.v. technical quality of media-clear sound and sight.)					
Add Number of Checks in Each Column					
Subtotal Inflated (Multiply Number of Checks by Respective Weights)	x5___	x4___	x3___	x2___	x1___

Sum of Style and Format Points (Box B) [ ]

Content Points (Enter Box A) [ ]

Total Points: Content plus Style and Format (Boxes A and B) [ ]

<u>Rating Summary</u>

Total Points:
62-70 Recommended as of Superior Quality
49-61 Highly Recommended
36-48 Recommended
23-35 Recommended with Reservation
14-22 Not Recommended

12 COMPARING MEDIA

SKILLS REINFORCED BY THIS ACTIVITY

Critical Thinking
Listening
Writing
Reading

PERFORMANCE OBJECTIVE

Students rate and evaluate three modes of presenting career information.

MATERIALS

* Brochure on a specific career field (e.g., nursing) for each class member;
* A cassette giving information on that same career;
* A film or filmstrip giving information on that same career;
* Review instrument (as shown in Activity #11);

Note: It may not be possible to obtain career resources in all three media for one occupation. If this is so, the effectiveness of the activity is maintained by comparing different occupations illustrated by the three media. The teacher may wish to obtain materials reviewed and abstracted in Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, or other locally available resource listings of career information.

* Mimeographed question sheet on the apparent strengths and weaknesses of a given medium.

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: two to four hours;
* Class Time: one to two sessions;

  (Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

Before class begins, career brochures and question sheets selected by the teacher are placed on each student's desk. As the students enter and begin to browse through the distributed materials, they are instructed to read the brochure. The teacher may then ask the class: "Would you rather read this, watch a movie or hear a tape about it?" The students discuss their expectations in terms of what they perceive as valuable in each of the media forms. The class may develop their own form for use in the review process or use the form developed by the Adult Career Education Resources Survey in Activity #11. Students are then requested to complete the review sheet on the brochure's strengths and weaknesses.

The teacher then plays the career cassette for the class. Again, students react orally, then complete the review sheet.

The teacher shows the film, elicits oral responses, and has students review the film utilizing the review instrument.

Following the triple presentation, students discuss their reviews and reasoning. The teacher emphasizes that these assessments serve as guidelines and teaching tools demonstrating to each student the value of his or her opinions.

Variation: If the class shows a variety of career interests, the class may be split into groups. The teacher can select a group leader prior to class, explain the activity to the student leader, and allow this student to carry out the teacher role in another room. If materials and space are available, several groups can conduct this activity simultaneously.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Developing assessment criteria both objectively and subjectively;
* Development of oral, written, and verbal expression;
* Exposure to career information.

POTENTIAL POPULATIONS FOR UTILIZATION

* ABE students;
* GED students;
* Adult students located in urban, suburban, or rural areas;
* Adult students of varied ages, socio-economic, racial and ethnic backgrounds;
* Women students entering or reentering the workforce.

13 WHAT DO THE WANT ADS SAY

SKILLS REINFORCED BY THIS ACTIVITY

Critical/Analytical Thinking
Communication/Listening

PERFORMANCE OBJECTIVE

Students investigate three classified advertisements for jobs to ascertain accuracy in want ads. They analyze content of the want ad and then learn what the job really requires by interviewing hiring personnel found through ads.

MATERIALS

* Classified advertisements

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: two hours;
* Class Time: one to two sessions;

  (Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

Each student is asked to bring to class the classified section of a current newspaper. Three want ads of interest to the student and about which he or she would like more information are to be circled. Discussion follows on truth in want ads and how to interview to determine what the employer is looking for in a job candidate. The teacher expresses confidence in the student's ability to perform the job duties and offers encouragement. During the next week students ascertain if the jobs advertised are what they appear to be by talking to people offering the

jobs, contacting employment agencies, going for interviews, etc. The company or agency should be informed by students that this is a career exploration activity which is being conducted for educational purposes. At the conclusion of this exercise, students report back to the group on how their original impressions differed from or were the same as the actual jobs and how they discussed the ads with the "prospective" employers.

Next, students analyze in group discussion their own career goals in terms of what they will need to tell an interviewer, based on what they learned through the simulated interviews. It is here that students have the opportunity to articulate their career goals as a by-product of researching the occupation.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Research skills developed;
* Career development stressed;
* Gained knowledge and self confidence in interview situations;
* Logical thinking exercised;
* Confidence in social/public situations;
* Telephone skills

POTENTIAL POPULATIONS FOR UTILIZATION

* Advanced ABE students;
* Adult students located in urban, suburban, or rural areas;
* Adult students of varied ages, socio-economic, racial, and ethnic backgrounds;
* Women students entering or reentering workforce.

14 PERSONALITY FACTORS IN WORK CHOICES

SKILLS REINFORCED BY THIS ACTIVITY

Critical Thinking
Listening
Social Interaction

PERFORMANCE OBJECTIVE

Students formulate in writing personality qualities required by specific careers.

MATERIALS

* Career filmstrip (such as one from the DISCOVERY SERIES produced by Visual Education Corporation for Scholastic Press, 50 W. 44th Street, New York, New York 10036 or GETTING AND KEEPING A JOB, Guidance Associates, 41 Washington Street, Pleasantville, New York 10570. Filmstrip listings may also be obtained from Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, or other locally available resource listings of career information);
* Mimeographed worksheet, as developed by student comments.

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: one to two hours;
* Class Time: one to two sessions;

  (Actual time if subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

Prior to presentation of a career filmstrip, the teacher discusses with the class relationships between personality and career suitability or job choice. An important point to raise is the observation that what an individual expresses about himself

and his occupation may provide important clues to his personality. The career filmstrip is then shown. To detect clues discussed previously, the teacher asks the class to recall indicative statements made by the individuals in the filmstrip. Phrases such as "The more money you make, the better you can eat," and "I'm happy, my wife's happy, I'm just an ordinary guy trying to do his job every day," should be cited and written on the chalk board. A filmstrip which provides a teacher's guide would be helpful in this activity.

After students have compiled a listing of quotes by each character, the teacher transfers these statements to a stencil and makes copies for the class. Beside each statement the teacher leaves room for students to check answers to three questions: (1) Do you agree with the character's assessment of himself? (2) Do you think that the personality traits depicted in the filmstrip reinforce the person's suitability for the job? (3) How important are personality factors in career choice in a time of economic instability? At the next class meeting students complete the reproduced sheet. (It may be necessary to re-show the filmstrip.) Students compare their estimations with one another after completing the sheets in a class discussion.

Note: A motion picture film might effectively be substituted for a film strip.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Increased self-awareness;
* Increased sensitivity to the many facets of each job or career situation;
* Expanded general career awareness;
* Practice in listening for specific information.

POTENTIAL POPULATIONS FOR UTILIZATION

* Adult evening high school students;
* Adult students located in urban, suburban, or rural areas;

* Adult students of varied ages, socio-economic, racial and ethnic backgrounds;
* Women students entering or reentering the workforce.

15 CAREER DISPLAY

SKILLS REINFORCED BY THIS ACTIVITY

Critical/Creative Thinking
Reading
Public Speaking
Listening
Interviewing
Letter Writing

PERFORMANCE OBJECTIVE

As a member of a resource group, each student contributes to the creation of a relevant and informative career display.

MATERIALS

* Career information in a variety of media (print and audio/visual). The teacher may wish to obtain materials reviewed and abstracted in Resources: Recommendations For Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, or other locally available resource listings of career information.)

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: two to four hours;
* Class Time: three sessions;

  (Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

After discussion, the class decides on approximately four career families related to their classwork.

Note: Career fields (i.e., clusters) utilized by the Adult Career Education Resources Survey may be reviewed in this book on page 73. These clusters are detailed in the Introduction of Resources: Recommendations for Adult Career Resources, Supplement.

Once the fields have been selected, the class divides itself into four groups, each of which is to be responsible for setting up a representative display of a career family. Each display may include:

A. A map of the United States on which concentrated areas of job opportunities in the chosen career family have been superimposed;

B. A growth chart of job opportunities in the career family from the past two decades through the next three decades;

C. Student produced or gathered pictures, sketches, slides, photographs or films of workers functioning in their job environments;

D. Pictures or actual examples of the tools or resources used by each worker.

Most information required can be found in career films or printed literature. However, a more realistic display generally results from visiting places of work. Student groups should be encouraged to visit job locations where they can photograph and speak with workers.

Approximately two to three weeks after assignment, each group presents its display during class. The designated speaker for the presenting group should delve into career working conditions, salary, and hours. Anecdotal experiences involved in putting together the displays may be included in the report. Students should be allowed ample time to look over the presenting group's work.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Organization skills developed;
* Group dynamics and production utilized;

* Community resources tapped;
* Artistic talents broadened;
* Career knowledge expanded;
* Practice in map and graph reading skills.

POTENTIAL POPULATIONS FOR UTILIZATION

* Advanced ABE students;
* Adult students located in urban, suburban, or rural areas;
* Adult students of varied ages, socio-economic, racial, and ethnic backgrounds;
* Women students entering or reentering workforce.

16 CAREER FILE

SKILLS REINFORCED BY THIS ACTIVITY

Critical/Organizational Thinking

Library Skills

PERFORMANCE OBJECTIVE

Students develop a system for filing career literature.

MATERIALS

* Career information (The teacher may wish to obtain materials reviewed and abstracted in Resources: Recommendations for Adult Career Resources, Supplement, a publication developed by the Adult Career Education Resources Survey, or other locally available resource listings of career information).
* Large (4 inch) three ring binder;
* Hole punch;
* Stapler;
* Manila dividers with pockets;
* Marking pens.

TIME REQUIRED FOR ACTIVITY

* Advance Preparation Time: eight to twelve hours;
* Class Time: one to two sessions;

  (Actual time is subject to the level of academic development and involvement of each teacher and class. Time length is given only as a guide.)

SUMMARY OF ACTIVITY

The purpose of this activity is for students to develop a career materials file utilizing an organized system. The system should be designed to facilitate individual student usage of the career materials. The teacher should initially lead a class discussion on the rationale of an orderly filing system. The teacher could present the cataloging system developed by the Adult Career Education Resources Survey and detailed in the introduction to Resources: Recommendations for Adult Career Resources, Supplement. The system might be utilized in this exercise. Its main career cluster headings are given below:

01.000 ADMINISTRATION AND MANAGEMENT
02.000 COMMUNICATION
03.000 CONSTRUCTION
04.000 EDUCATION
05.000 FINE ARTS
06.000 HEALTH SCIENCES
07.000 INDUSTRIAL PRODUCTION
08.000 NATURAL RESOURCES AND ENVIRONMENT
09.000 NATURAL SCIENCES
10.000 OFFICE AND CLERICAL
11.000 REPAIR AND MECHANICS
12.000 SALES AND MARKETING
13.000 SERVICE (PERSONAL, PROTECTIVE, PUBLIC, OTHER)
14.000 SOCIAL SCIENCES
15.000 TECHNICAL SCIENCES
16.000 TRANSPORTATION

It may also be suggested that the class develop its own system (alphabetically, by subject matter, career cluster area, reading level, etc.)

Once students decide upon an organizing scheme useful for their purposes (such as by the subjects they study or by reading levels, etc.), they then select a vehicle for putting the system in use that is suitable for their needs. This may entail comparing the benefits of utilizing a file drawer, library-type file boxes or manila folders. Particular students may be assigned the task of integrating materials into the system (cataloging, inserting into folders, etc.) with others responsible for binding the entire organized collection of career materials, if bound collections are desired. The file should allow for expansion as new career materials are obtained.

Note: For maximum success, this activity should be voluntary.

BYPRODUCTS OF SUGGESTED ACTIVITY

* Organization of thoughts and materials stressed;
* Practice with a filing system developed.

POTENTIAL POPULATIONS FOR UTILIZATION

* Pre-GED students;
* Adult students located in urban, suburban, or rural areas;
* Adult students of younger ages, varied racial, socio-economic, and ethnic backgrounds;
* Women students entering or reentering workforce.

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PERSONAL AUTHOR: EDMONDSON, ROBERT J.

DESCRIPTOR: *CAREER EDUCATION; *ELEMENTARY SECONDARY EDUCATION; *PROGRAM DESCRIPTIONS; DEVELOPMENTAL PROGRAMS; INTEGRATED CURRICULUM; JOB PLACEMENT; RESOURCE CENTERS; FIELD TRIPS

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ABSTRACT: DURING THE PERIOD OF JULY 1974 TO JUNE 1975, THE BRISTOL, CONNECTICUT CAREER EDUCATION PROGRAM CONTINUED IN ITS EFFORTS TO "INFUSE" CAREER EDUCATION CONCEPTS INTO THE EXISTING K-12 ACADEMIC CURRICULUM. TWENTY SCHOOLS PARTICIPATED IN THE SECOND YEAR OF THE PROGRAMS, WHICH INCLUDED PLACEMENT AND RESOURCE CENTER COMPONENTS. THE PROGRAM ALSO MADE USE OF CAREER SPEAKERS, FIELD TRIPS, AND EXPLORATION SITE VISITS. THE DIRECTION OF THE PROJECT IN THE ELEMENTARY GRADES WAS TO PROVIDE THE STUDENTS WITH AN AWARENESS OF THEMSELVES AND THE WORLD OF WORK. THE EMPHASIS IN THE MIDDLE SCHOOLS WAS ON "HANDS-ON" EXPERIENCE. IN GRADES 9 THROUGH 12, THE FOCUS WAS ON DECISIONMAKING, CLUSTER SPECIALIZATION, AND CAREER EXPLORATION THROUGH JOB SITE EXPERIENCES. THIS REPORT PRESENTS THE GOALS AND OBJECTIVES OF THE VARIOUS COMPONENTS, DESCRIBES THE PROJECT DESIGN AND PROCEDURES, AND SUMMARIZES THE RESULTS AND ACCOMPLISHMENTS. CHARTS OF CAREER SPEAKERS AND OF EXPLORATION DAY AND FIELD TRIP SITES ARE INCLUDED, ALONG WITH PROJECT-GENERATED CORRESPONDENCE. (NJ)

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INTERIM REPORT

Project No. V361170
Grant No. OEG-0-73-5301

Penetrating School Strata
Through Career Education

Exemplary Project in Vocational Education
Conducted Under
Part D of Public Law 90-576

Robert J. Edmondson
Bristol Board of Education
985 Farmington Avenue
Bristol, Connecticut 06010

July, 1975

VT 102 480

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The project reported herein was performed pursuant to a grant from the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

Robert J. Edmondson
Bristol Board of Education
985 Farmington Avenue
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July, 1975

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Summary of the Report

July 1, 1974 to June 30, 1975

Summary

Period Covered: From July 1, 1974 to June 30, 1975

Project Goals and Objectives:

The Bristol, Connecticut Career Education Program funded by the United States Office of Education grant under Part D of Public Law 90-576, has continued during the past twelve months curricular revision activities relating career education concepts to classroom materials and supportive activities from kindergarden through grade twelve levels. The major goal of the project has been to "infuse" career education concepts into the existing academic subject areas, with a wide variety of support activities for the classroom teacher to help supplement the concepts learned in the academic classroom.

The objectives of the Bristol Career Education Program are as follows:

GRADES K-8 OBJECTIVES

1. To enable students to develop a more positive self-concept and greater understanding of self.

2. To enable each child to display an understanding of the relationship between his own abilities and limitations in terms of the world of work.

3. To develop and expand the pupil's knowledge about a variety of clusters of occupations.

4. To give teachers knowledge of career education concepts, career awareness, career exploration, career preparation, clusters, and self-awareness techniques.

5. To implement curriculum patterns that will illustrate the relationship of school subjects to the world of work.

6. To provide for continuous curriculum development, revision, and evaluation.

7. To enable students to have access and greater understanding of the many community resources available for them.

GRADES 9-12 OBJECTIVES

1. To provide each student with opportunities regardless of his ultimate career goals, to have marketable skills that will enable him to enter the labor force when the need or desire arise for him to do so.

2. To enable each student who desired to undertake advanced preparation, whether it be in a post-secondary technical

school, college, university of business school to be so equipped with the necessary prerequisites to understand this advanced training.

3. To provide opportunities for students to participate in meaningful occupational explorations.

4. To provide greater encouragement for student enrollment in vocational education programs.

5. To provide greater encouragement for student enrollment in work experience programs, and a wide range of work experiences.

6. To provide intensive guidance and counseling in preparation for employment and/or future education.

7. To develop career information programs to be carried out by departments within the scope of the curriculum.

8. To establish a continuing avenue of communications between school, business, industry, and community.

9. To follow-up all drop-outs and graduates and to use such data in the planning of future programs.

OBJECTIVES OF THE PLACEMENT COMPONENT

1. To locate and isolate significant career job opportunities in the community which can be offered to existing Bristol students.

2. To offer such job opportunities to said students through a system which allows for clear and precise communications between employers, students and concerned education officials.

3. To utilize information retrieval forms which permit a matching of student interest and abilities with job specifications.

4. To develop processes which allow for the rapid identification of existing students who would be interested in using this placement service.

5. To provide for the following systems within this placement service:

   a). Reporting

   b). Referral

   c). Follow-up analysis

   d). Program revision

Summary (Continued)

RESOURCE CENTER OBJECTIVES

1. To serve as a dependable source of supply for the career education specialists and others availing themselves of the services of the program.

   a. To satisfy their needs, whether they be for some tangible item already in the Center, for something which must be developed especially to meet their particular need, or for one of the so-called "people resources" which are often the most difficult to produce.

2. To serve as a source of suggestions for both new materials and new methods which the career education specialists cannot keep abreast of on their own.

   a. These suggestions cover both commercially and locally developed career education aids as well as materials and ideas borrowed from other career education programs.

3. To serve as an on-going educational influence on those involved in the program by providing classroom teachers an understanding of what career education can offer them and their students through in-service teacher training sessions.

   a. These range from workshops designed specifically to acquaint teachers with the services of the Resource Center to those which involve participants in various activities which can be taken to the classroom and used to infuse career education into the curriculum.

Procedures Followed:

The procedures followed for the second year of the program continued to be those established during the course of the first year. After researching and defining procedures to be followed for curriculum revision within the Bristol Public School System, these established procedures are being implemented. Continued teacher involvement in any career education undertaking seems to be the key. Teachers are asked to try and incorporate at least one of the concepts of Career Education into their existing lesson plans whenever possible. Each of these activities are developed with the help of the specialist at the teacher's appropriate level. Completed activities were gathered for the year and will be published and issued in the Fall of '75 as a supplement to the three published Career Education Curriculum Guides.

Committees of teachers are in the process of being identified who will work during the summer of '75 in reviewing and re-writing curriculum materials developed to date.

Results; Accomplishments:

In order to provide an overall summary account of the results and accomplishments of the Bristol Career Education Program, reference will be made to Table One listed below and the appendix showing involvement of the schools in the following categories: career speakers; field trips; and exploration sites. Career education proved to be a significant part of the total instructional program within the identified project schools. Positive attitudes and acceptance on the part of parents, students, business community, teachers and administrators proved to be well above expectations for the second year of the program's operation.

TABLE ONE

School	Population	Serviced Population	Percent Serviced
Elementary (K-8)			
St. Ann's	377	309 (appx.)	82%
South Side	659	428 (appx.)	65%
Mountain View	383	260 (appx.)	68%
Edgewood	441	317 (appx.)	72%
Hubbell	412	264 (appx.)	64%
Ivy Drive	452	276 (appx.)	61%
Northeast	964	858 (appx.)	89%
Bingham	335	154 (appx.)	46%
Callen	414	145 (appx.)	35%
Greene-Hills	407	73 (appx.)	18%
O'Connell	488	234 (appx.)	48%
Stafford	606	164 (appx.)	27%
West Woods	652	443 (appx.)	68%
St. Stanislaus	230	69 (appx.)	30%
St. Anthony's	290	44 (appx.)	15%
Jennings	501	110 (appx.)	22%
Memorial Boulevard	793	468 (appx.)	59%
South Chippens	17	17 (appx.)	100%
Secondary (9-12)			
Bristol Central	1750	1,068 (appx.)	61%
Bristol Eastern	1844	1,235 (appx.)	67%
St. Paul's	970	815 (appx.)	84%
TOTALS	12,985	7,751 (appx.)	60%

As a result of the effectiveness of the first year of the Bristol Career Education Program, the elementary level (K-8) saw an expansion from 7 schools serviced during the first year to 17 schools serviced during the second year. The secondary level (9-12) saw no increase in the number of schools serviced, since the program was already operational to the maximum during the course of the first year.

Summary (Continued)

Evaluation:

A third party evaluator was secured to evaluate the program to assess the effectiveness of each level and the overall success and value of the total program. IBEX, Incorporated, of Durham, North Carolina, was selected again for the second year as the third party evaluator. In addition, the Career Education staff was involved in an informal self evaluation for the twelve month duration of the second year of the program.

Conclusions and Recommendations:

As a result of the second year of the Bristol Career Education Program, it is concluded that the initial set of needs and goals on which the project was funded proved to be realistic and beneficial to the local Bristol School System. The involvement developed a better and more meaningful educational experience for the students of the twenty schools that made up the project sites. This involvement produced a positive base of experiences which in turn founded expertise, materials, awareness, and support for the philosophies and concepts of career education on which further direction and expansion programs can be built in the Bristol Public and Non-Public Schools.

Body of the Report

Body of the Report

Problems:

In the quest to provide meaningful educational experiences in our public school educational system, many dramatic changes have occurred in techniques, content, and philosophy. In today's educational institutions, nothing is more pertinent than providing every youth with the capability to make intelligent career decisions and the opportunity to prepare for entry and progress in such careers.

It has become apparent in recent years that public school education must re-identify itself and establish more efficient means for students to have greater validity in their career decisions through sensible choice rather than haphazard chance.

The original Bristol, Connecticut proposal, titled Penetrating School Strata Through Career Education, Problem Section describes a variety of circumstances and situations which appear to have created a stagnation in the educational change process. Despite many excellent and varied attempts to foster the development of new perspectives and curricular approaches, the results appear to have had limited impact upon the entire system.

Frequently, old and new curricular processes appeared irrelevant to the needs of students and the community. Often this appeared to be traceable to varied cultural and value orientations found in our city. Further, a number of the changes developed have been remedial in design rather than prescriptive. New programs in the educational system appeared to have been geared philosophically on correcting and/or ignoring what values and skills students brought to class; rather than allowing for the diversity of these attributes (and subsequent demonstrations on how these characteristics can still benefit each individual in his future).

To quote Sydney Simon, "Students, no less than adults, face problems and decisions every day of their lives. Students, too, ponder over what and how to think, believe, behave. So often what goes on in the classroom is irrelevant and remote from the real things that are going on in student's lives - their daily encounters with friends, with strangers, with peers, with authority figures; the social and academic tasks that assault or assuage their egos. Young people are being asked and are asking themsleves important personal and theoretical questions that will lead them to important decisions and action."[1]

Thus, the key Bristol educational administrators, charged with the designing of the Career Education proposal, attempted to deal with affective components of the difficulties the system was experiencing in

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[1] Simon, Sydney, etal; Values Clarification; Hart Publishing Company, New York; 1972; page 13.

"normal" curricular approaches. Further, such affective elements were to be coupled with increased and sequential experiences with the empirical World of Work. To aid in this development, the community itself was designed into the proposal write-up as a valid place for learning experiences (heretofore, limited use prevailed of this invaluable resource for learning). From simple field trips to extended internships and placement, the Career Education program was to tap all possible and viable learning situations. Such community involvement was to demonstrate to each and every student that all work has dignity-if it is something enjoyed and believed in by the individual involved. The other major transfer of learning hoped for by the proposal's design was simply that different people enjoy different values and life styles. Therefore, identification of these varying characteristics in adults by involved youth would be of assistance in selecting a potential occupation(s). Provisions for the development of and changes in view in regard to these affective components of learning were also built into the design of the original proposal.

The document, Penetrating School Strata Through Career Education, cited two major community concerns with which the school system is intimately involved. The first is that the city has been documented as an economically depressed area. Secondly, the 1970 Community Development Action Plan (CDAP) Report indicated that educational expectation criteria were not in keeping with the system's goal to "provide each child with an opportunity for, and motivation toward, achieving his best educational and personal goals." Both concerns indicated a need for extensive changes in curriculum at all levels of education.

The proposal recognized the fact that curriculum revision could not occur without two crucial resources: involved teachers and banks of people and material resources.

Therefore, the proposal was designed to have a large staff complement. All told there are six professional people whose prime task is to help teachers develop curricular revisions. The Career Education staff accomplishes by bringing to bear additional sets of resources. For example, community involvement, commercially prepared Career Education materials, and self-produced instructional materials all act as catalysts in the infusion of career education concepts with existing curricula.

Thus, the teacher enthusiasm needed to develop change in the direction of career education is fostered. Reinforcing their (the teacher's) commitment to changes in curriculum, the proposal outlined extensive provisions for teacher workshops and college courses. Significantly, these provide for a variety of reimbursements to involved teachers. From payment of course fees and tuition to remuneration for after hours attendence of a workshop, the teacher is treated as a professional member of a team.

The planned curricular revision process was of unique design. Its orientation was based on the inductive concept of maximum contribution to a total end product. Teachers in the voluntary process of trying career education concepts and resources were to capture the essential elements of each of these activities. These recordings were then to be gathered, colated, organized, sequenced, and related to existing curricular approaches. In this way, a "living, on-going" infusion process was built into the proposal's design.

Penetrating School Strata Through Career Education directly involves the parochial school as well as the public sector. Additionally, cooperative ventures with a number of other educational and public service agencies has been written into the program's design.

The proposal attempted to deal with a workable process for the implementation of the project. To aid in the guidance and direction of staff efforts, a number of differently composed advisory groups were established and periodically called upon. The members of these groups were to come from a variety of backgrounds: service agencies, business and industry leaders, education, parents, and concerned students. To this end, three major advisory groups have been established:

1. The Career Education Planning Committee (educators)

2. The Bristol Career Education Advisory Board (educators, parents, students, and community leaders)

3. The Bristol Occupational Education Advisory Council (educators, parents, students, and community leaders)

The original Career Education proposal, Penetrating School Strata Through Career Education (1972), states as a problem that "it is increasingly more apparent that one of the major problems of this school system and others in Connecticut is the unrealistic expectation placed on our students, especially those whose cultural background may be deprived or lacking in stimulation." It further states that "it is the intention of this proposal to use career education as the vehicle for a massive change of perspective in the Bristol School System."

The direction of the project in the elementary grades was to provide the elementary students both with an awareness of themselves and an awareness of the world of work.

In the middle schools, we will provide "hands on" experiences. We will give students personal contact with leaders from business, industry, and organized labor. We will introduce a "shadow" program whereby students will follow an employee for several hours or longer so as to understand the dimensions of his work. The use of games, and related

educational problem-solving exercises so popular with today's youth, will be stressed so as to stimulate important aspects of selected occupations. Because of the recognized physical and behavioral changes inherent in this age bracket, we envision individual and group exercises working in close harmony with counselors or teachers.

Career education in grades 9-12 will emphasize increased self-awareness in terms of decision-making, cluster specialization and career exploration through job site experiences in such Bristol companies as Radio Station WBIS, Family Services, springmaking shops, food services sites, the Bristol Hospital and other such concerns and companies which will participate in this program following the workshops planned for community information and involvement.

Goals and Objectives:

Overall project goals and objectives were identified in the preceding section of this report. The needs were categorized into project components that were known as (1) elementary component, (2) middle school component, (3) high school component, (4) placement component, and (5) Career Resource Center component.

1. Elementary and Middle School Component

The major objectives of the elementary and middle school component were:

A. To enable students to develop a more positive self-concept and greater understanding of self.

B. To enable each child to display an understanding of the relationship between his own abilities and limitations in terms of the world of work.

C. To develop and expand the pupil's knowledge about a variety of clusters of occupations.

D. To give teachers knowledge of career education concepts, career awareness, career exploration, career preparation, clusters and self-awareness techniques.

E. To implement curriculum patterns that will illustrate the relationship of school subjects to the world of work.

F. To provide for continuous curriculum development, revision, and evaluation.

G. To enable students to have access and greater understanding of the many community resources available for them.

2. High School Component

The major goals and objectives of the high school component were:

A. To provide each student with opportunities regardless of his ultimate career goals, to have marketable skills that will enable him to enter the labor force when the need or desire arise for him to do so.

B. To enable each student who desired to undertake advanced preparation, whether it be in a post-secondary technical school, college, university or business school to be so equipped with the necessary prerequisites to understand this advanced training.

C. To provide opportunities for students to participate in a meaningful occupational exploration.

D. To provide greater encouragement for student enrollment in vocational education programs

E. To provide greater encouragement for student enrollment in work experience programs, and a wide range of work experience.

F. To provide intensive guidance and counseling in preparation for employment and/or future education.

G. To develop career information programs to be carried out by departments within the scope of the curriculum.

H. To establish a continuing avenue of communications between school, business, industry, and community.

I. To follow-up all drop-outs and graduates and to use such data in the planning of future programs.

3. Placement Component

A. To locate and isolate significant career job opportunities in the community which can be offered to existing Bristol students.

B. To offer such job opportunities to said students through a system which allows for clear and precise communications between employers, students and concerned education officials.

C. To utilize information retrieval forms which permit a matching of student interest and abilities with job specifications.

D. To develop processes which allow for the rapid identification of existing students who would be interested in using this placement service.

E. To provide for the following systems within this placement service:

1. Reporting

2. Referral

3. Follow-up analysis

4. Program revision

4. Resource Center Component

The major objectives of the Career Resource Center were:

1. To serve as a dependable source of supply for the career education specialists and others availing themselves of the services of the program.

   a. To satisfy their needs, whether they be for some tangible item already in the Center, for something which must be developed especially to meet their particular need, or for one of the so-called "people resources" which are often the most difficult to produce.

2. To serve as a source of suggestions for both new materials and new methods which the career education specialists cannot keep abreast of on their own.

   a. These suggestions cover both commercially and locally developed career education aids as well as materials and ideas borrowed from other career education programs.

Body of the Report (Continued)

3. To serve as an on-going educational influence on those involved in the program by providing classroom teachers an understanding of what career education can offer them and their students through in-service teacher training sessions.

   a. These range from workshops designed specifically to acquaint teachers with the services of the Resource Center to those which involve participants in various activities which can be taken to the classroom and used to infuse career education into the curriculum.

Description of General Project Design and Procedures Followed:

The reporting period for this second interim report is July 1, 1974 to June 30, 1975. The overall purpose and direction of the project was based primarily for the development of the specific goals and objectives which were previously stated in the prior section of the report.

As previously reported, the Career Education Program on the elementary level saw an increase from the original four target schools of the first year to seventeen participating schools in the second year. Procedures followed were those established during the course of the first year as reported in Pages 12-13 of the Interim Report for the school year '73-'74.

For the junior high school portion of the program there were seven target schools for the 74-75 school year. This includes three non-public schools, St. Stanislaus, St. Ann, and St. Joseph, and four public schools, Memorial Boulevard, West Woods, Stafford, and Northeast. All of these schools except Memorial are K-8, and the figures below reflect only the 7-8 populations.

School	Total Students	Grade 7-8 Teachers
St. Stanislaus	49	2
St. Ann	115	4
St. Joseph	122	4
Memorial Boulevard	786	47
West Woods	352	17
Stafford	230	13
Northeast	368	19

As last year, a flexible approach was used in allowing each school to participate in the career education program in a way that would be most effective to it, the only requirement being that it meet at least one of the objectives mentioned in the previous section.

Exact procedures followed for the junior high school specialist were those reported in the Interim Report for the school year 73-74 on Pages 13-15.

At each of the three high schools, a Career Guidance Specialist is stationed to undertake all nine of the secondary objectives. This arrangement has proven quite beneficial in that these specialists are now identified, constantly, as a part of each school's faculty.

The basic implementation design is the same from school to school. The Career Guidance Specialist works primarily with the Guidance Director of each school. From this base, the specialist then works with department heads, teachers and counselors on:

1. determining appropriate programs for cooperation between these various personnel and the Career Education Department.

2. determining needs of students in terms of planned career explorations.

3. determining curricular and resource needs of teachers and students and coupling these to one or more of the objectives of the Career Education Program.

4. maintaining thorough communication with both the principal and guidance director so that a clear, precise infusion of grade 13 and 14 cooperatives can be incorporated into the existing high school program (where and when possible).

Each of the three schools has then tailored, around the above design, specific methods of operation. Therefore, certain aspects of the secondary program may be more developed in one school than at another. However, each school, in turn, has developed programs in other areas of the original set of Career Education objectives. This development has in turn provided in depth piloting for all the major objectives of the secondary program.

The program design developed at Bristol Eastern, Bristol Central and St. Paul's this year included four components: curriculum infusion, exploration day program, placement and follow-up. The original concept of curriculum infusion has been further developed during the 1974-75 school year. The process of working with teachers begins at the grass roots level and proceeds upward. The specialists: Mr. Edward Phelan, Mr. Dave Doherty, and Ms. Kathy Quinn work directly with concerned teachers keeping in close contact with department heads, guidance personnel and the administrative staff. A follow-up study was carried out at all three high schools. The Career Exploration Program offers students in grades 9-12 the opportunity to observe and try out in a limited way conditions of work. A Placement Program has been developed and is in operation.

CAREER EXPLORATION PROGRAM

The Career Exploration Day Program was initiated in the three high schools in order to provide an opportunity for students to observe and

try out in a limited way conditions of work involved in a particular job. There has been developed and continuously updated a community resource list which is used to place students. The high school specialist is responsible for the operation of the program in his or her particular school. This includes:

1. dissemination of information to students and faculty.

2. acceptance of applications and other pertinent data from interested students.

3. referral of applications to community resource person.

4. notification of placement to students.

5. follow-up after exploration day has been completed.

PLACEMENT

Another area of responsibility of the Career Education Program is the development of a Placement Program. Within the scope of the placement program, the high school specialists are responsible for the following activities:

1. arranging seminars for senior students conducted by local personnel directors.

2. conducting follow-up activities on placement.

3. with the cooperation of the guidance departments, the specialists are responsible for matching individual students with employer job request

FOLLOW-UP STUDY

A follow-up survey was sent to 750 students of the class of '74. Two hundred ninety-three students responded to the questionnaire. The random sample included graduates from Bristol Eastern, Bristol Central and St. Paul's. The intent of the study was to determine if these graduates were working toward career goals that they set for themselves in high school.

The questionnaire was designed to gather the following kinds of information: job success, influences on career choice, and changing career interests. An attempt was made to show the relationship between career choices made in high school and post high school career choice. An assessment as to the graduate's need for assistance in the transitional phases from either one educational program to another or from an educational program to employment were made. Student comments were requested. Several alumni agreed to have their names placed on the community resource list.

CURRICULUM INFUSION

Process of curriculum infusion takes place in grades 9-12. Career specialists work with teachers to incorporate career concepts into the already existing curriculum as follows:

A. Career Speakers: Resource people are brought from outside the physical school community to show how work and the subject development are related i.e. Pharmacist with math class; C.P.A. with business class etc..

B. Field Trips: Experiences designed to permit students and staff to leave educational institutions in order to observe and learn about specific work situations in their real environment i.e. Economics class to the New York Stock Exchange; Computer class to Data Processing Department at Superior Electric.

C. Media: Films, filmstrips, A.V. materials - Career specialists make available career related materials that can be introduced as part of curriculum infusion process i.e. On the Job for Business Department; Grooming Job Applicants for Cooperative Work Experience Class.

D. Materials and Supplies: Teachers can request supplies and materials for classroom use that complement career unit development.

E. Workshops for Teachers: Teacher-counselor workshops are conducted to explain the overall purpose of career education and to demonstrate the techniques and devices that may be used to implant concepts into related subject areas i.e. Mathematics, Social Studies, Values Clarification.

F. Exploration Day: As a follow-up to career speaker presentation made in a particular subject area, the availability of exploration day activities are presented to interested students.

The procedures followed for the Career Resource Center are those that have been developed during the course of the school year '74-'75 and follow very closely the three main objectives of this component of the Bristol Career Education Program.

I. Supply Function of the Career Resource Center

A. A card file system is currently being installed to keep track of every piece of non-consumable equipment purchased with program funds. The system includes both hardware and software and will replace the equipment list currently in use.

B. Work has been completed on a revision of the Provisional Resource Bibliography which will keep teachers up to date

on what materials the Center can offer them.

C. Various hardware items have been purchased by the Resource Center Director to supplementthe burden placed on the school system's audiovisual center by the many activities the Career Education Program is running. Among these are tape recorders, 16mm projectors, a slide projector, and television equipment.

D. Labor market projections for both the Hartford area and the entire State of Connecticut are being solicited from the State Labor Department and passed on to guidance counselors throughout the system. Nationwide figures are also available in the Center from such publications as The Occupational Outlook Handbook and The Occupational Outlook Quarterly.

E. An occupational information file is maintained in the Resource Center. The file now consists of over 1,000 pieces of information on specific jobs. It is organized for easy access and is growing daily. Packets of material from this file are being compiled to be sent out to teachers who wish to relate their subject areas to specific careers.

F. The Resource Center houses a large quantity of printed materials on specific careers which has been supplied by various employers and organizations. Much of this material is in sufficient quantity to be distributed to large numbers of students. Bulk mailings are continually being put together to solicit more of this material, and as it arrives it is sent out to school libraries and guidance offices.

G. Using the Community Resource Guide compiled this past summer as a foundation, a highly diversified collection of community resource people has been put together with the very able assistance of Mrs. Lillian Barnes of the Bristol Chamber of Commerce and Mrs. Joan Atkinson, Community Resource Aide. These community resources are used as career speakers, exploration day sites, and field trip sites. All arrangements are made by Mrs. Atkinson who has been very successful in managing this part of the program.

II. Materials, Methods, and the Suggestion Function

A. The Resource Center Director requests preview copies of new audiovisual programs on career education as they become available. These are passed on to teachers who evaluate them and consult with the career education specialists

regarding them. A decision on further use is then made.

B. The Resource Center Director has researched and visited several other career education programs to date. These visitations produce ideas for new activities which are passed on to career education specialists.

C. The newsletter of the Bristol Career Education Program, "The Exchange," is edited by the Resource Center Director. "The Exchange" not only carries reports on what is happening with career education in Bristol, but also serves as a forum for ideas and suggestions concerning career education activities from all staff members including the Resource Center Director.

D. Pertinent professional writings are kept in the Resource Center for the purpose of stimulating development of new career education activities. These are available to the career education specialists and to teachers.

III. In-service Training Function of the Career Resource Center

A. The Resource Center has played an important part in the Career Education Course offered in Bristol by the Bristol Career Education Program in cooperation with Central Connecticut State College. In addition to on-going assistance given to the course instructor, Mr. Carl Venditto, the Resource Center Director gave a presentation to the group on November 14, 1974 covering two related topics. These were, "Commercially Available Career Education Materials" and "The Offerings of the Career Resource Center."

B. The Center Director has arranged several visitations for staff members and other Bristol educators to view career education programs and resource centers outside of Bristol. These have included Asbury Park, New Jersey; The Curriculum Resource Center at Rhode Island College; New Britain, Connecticut; and the Career Resource Center at Roger Ludlowe High School in Fairfield, Connecticut. Other visitations are now being planned in hope that those involved will gain knowledge which can benefit our own program.

C. The Resource Center has hosted or sponsored teacher in-service workshops on self-awareness techniques and affective education, with several others currently in the planning stages.

D. Color slides taken during career education activities have been collated and arranged into presentations, some with sound, depicting the Bristol Career Education Program.

These are used for informational and instructional purposes on what career education in Bristol is doing.

E. The Resource Center Director keeps track of career education workshops, seminars, etc. offered by other school systems, vendors, and organizations and aids staff members in securing the opportunity to participate in as many of these as possible in order to develop further expertise in the career education field.

Results and Accomplishments:

All of the results and accomplishments of the elementary level of the program are contained in the Elementary Career Education Curriculum Guide K-6. A supplement due for issue in the fall of '75 will contain the major results and accomplishments of the second year of the program. The following is a sample listing of the elementary schools and an activity that was accomplished during the course of the second year of the project.

Edgewood - The kindergarten did a unit on nutrition and related it to the careers in the Health Cluster.

Mountain View - The sixth grade had a unit on Math and coordinated it to careers that use Math i.e. a toolmaker - using decimals and fractions.

Northeast - Sixth graders were doing a unit on the Health Cluster and were part of a mock disaster to the local hospital. All the students saw first hand what each person does in a hospital.

Ivy Drive - The first graders developed a unit on Marine Life by having an aquarium in the class and followed it up with a trip to the Mystic Sea Aquarium.

St. Anthony - The fifth and sixth graders were exposed to various careers in a Community Helpers unit, using speakers such as a lineman from the Connecticut Light & Power Company, policeman, fireman, postal employee, etc.

St. Ann's - The sixth graders put on their own career exposition by finding a cluster that they were interested in and writing to get information and samples. Then, they displayed their careers at a Parent-Teacher's Organization meeting and fair for the entire school.

St. Stanislaus - The sixth grade did an activity on careers with a newspaper, seeing first hand the careers at a newspaper firm.

O'Connell - The second graders were exposed in a Community Helpers unit and had as speakers a fireman, policeman, postman, and a mechanic.

Bingham - The sixth grade buile a puppet theater with a carpenter to see first hand what a carpenter does for a living and the tools and education he needs.

Jennings - The fifth graders did a unit on transportation with speakers such as a pilot and activities such as sending a weather balloon up into the air.

Greene-Hills - The kindergarten undertook a unit on Community Helpers and had an unusual experience of a field trip to a farm.

Callen - The third graders followed up a unit on Ecology with speakers from the local factories and Conservation Commission and a trip to a filtration plant.

Hubbell - The sixth grade had many hands-on units; one building a photographic darkroom and developing their own pictures; building their own work bench and having speakers from the Construction Cluster i.e. carpenter, electrician, etc.

West Woods - The sixth graders did a unit on transportation with speakers from an airline and also a travel agent.

Stafford - The sixth graders did a unit on arts and crafts by making their own candles and having a crafts fair.

South Side - The sixth grade did a unit on setting up a business by making signs and then developing the business to pay for their outdoor education experience.

Patterson - Grades 3-5 had a bike awareness activity to develop good bicycle habits with students.

Workshop for teachers - Affective Education for grades K-3, 10 sessions. Also another Affective Education workshop for grades 4-6, also 10 sessions.

Sharing Workshop - One for kindergarten on woodworking, one for primary grades, K-3, (career ideas), and one for intermediate grades, 4-6.

Career Education on the junior high level have led to a variety of activities. These range from a "hards-on" approach at one of the schools where students and teachers built and now manage a school store, a radio station, a bank, and an employment bureau. Another school had students involved in a semester project developing a personal "career scrapbook." Activities have taken all forms. They have included speakers, field trips, interviews, roleplaying, "hands-on" work, media construction, etc. A seventh and eighth grade curriculum guide has been developed that details many of these activities, with a supplement for this

guide due in the fall of '75.

Also developed this year was a Shadow Exploration Day Program, which allows eighth graders a chance to visit a job site and interview employees on a one to one basis. Three schools have been involved in this program since January, sending out 15 students into the community to learn about occupations of their choice first hand.

Results and accomplishments of the secondary portion of the Bristol Career Education Program (grades 9-12) involves curriculum infusion that takes place on a voluntary basis in grades 9-12 at all three high schools. These figures describe the level of involvement.

School	Total Staff	Staff Involved
Bristol Eastern	118	68
Bristol Central	99	62
St. Paul's	52	21

A 9-12 Curriculum Guide has been developed. This guide will be updated in the fall of 1975. Each Department Head in all three high schools has a guide. The guides summarize the Career Education activities that have been undertaken by the participating staff. The high school specialists have involved high school teachers in each of the following areas: English, Social Studies, Science, Mathematics, Languages, Industrial Arts, Art, Music, Distributive Education, Cooperative Work Experience, Business, Special Education and Physical Education in developing career education activities.

During the course of the year our community resource list has been expanded. Teachers have utilized community resource persons as career speakers and as resources for field trips. A total of 216 resource persons have made career presentations to high school students. The speaker presentations are listed by cluster and by the number of jobs represented within each cluster.

Cluster	Job Categories Represented
Agri-Business and Natural Resources	0
Business and Office	22
Construction	8
Consumer and Homemaking	6
Environment	8
Fine Arts and Humanities	5
Health	49

Cluster	Job Categories Represented
Hospitality and Recreation	3
Communications and Media	16
Manufacturing	18
Marketing and Distribution	11
Personal Services	15
Public Services	45
Transportation	10

Field trips are another vehicle used to help teachers and students discover the job opportunities that exist in the Hartford area. Thirty-two field excursions took place this year.

Guidance Outreach Projects have been initiated at Bristol Eastern. Counselors, career specialists, and teacher teams have worked together to develop career units for students in Community Studies I and II, English II-Typing I, Chemistry, Special Education.

Values and decision making aspects of career development have been incorporated into some classrooms at Bristol Eastern. In November a small number of Eastern staff were involved in an in-service Values Workshop. The workshop was designed to help teachers develop an awareness of the processes involved in making a career choice. These teachers have incorporated values, which rely on decision making, into classroom instruction in the following subject areas: English, Social Studies, Business and Cooperative Work Experience.

"Career Exploration" has acquired a hands on dimension. A formal Career Exploration Day Program was established.

EXPLORATION ASSIGNMENTS

School	Participating Students
Bristol Eastern	147
Bristol Central	43
St. Paul's	71

A follow-up study was completed. Seven hundred fifty students from all three high schools were surveyed. Two hundred ninety-three students responded. The questionnaire was designed to get at the process of career decision making and to obtain information regarding present career choices. Some students made comments relative to the

following areas: career planning, curriculum development, preparation for further education and post high school choices. Students listed in this order those persons having the greatest influence on the career choice they made: parents, teachers, part-time jobs, counselors, Business course, career speakers, work study, Industrial Arts. The list below describes the present choices made by the respondents.

Present Choice	Graduate Responses
Full-time Employment	71
Unemployed	4
Military Service	5
Continuing Education	177

Of these, thirty-two students requested assistance in educational planning or employment change.

A structured systematic program for placement involving schools, community and central office has been developed but the economic conditions and the lack of job demand in the community has hindered the implementation of the program. The job order bank to date has had two full-time job opportunities and these have been filled by registered students. Each career specialist ran a Placement Seminar Program utilizing community personnel directors. Every high school senior was exposed to this program.

The results and accomplishments of the Career Resource Center are that it is making its presence felt on all levels of the program; that the development of the Resource Center will be a continuing process, becoming more and more complete as the overall career education program progresses; and that the Resource Center and its director, through the threefold function of supplying, suggesting, and training, will endeavor to enhance the chances of the program's success to the fullest possible extent.

The Career Resource Center has produced its own brochure describing its major functions, a detailed material resource bibliography and a complete unit on Career Education and Outdoor Education.

Video tapes for classroom use have been produced representing the following cluster areas:

Fine Arts: Mime, Puppeteer, Museum Occupations, Craftsman (Potter, sculptor, painter, candlemaker, etc.)
Business and Office: Savings Bank Careers
Construction: Field Office Trailer Manufacturer
Health: Hospital Administrator

Also various programs have been produced on affective education, career role playing, self-awareness, and career exhibits.

Evaluation:

This section must be prepared by the third party evaluator following the general guidelines of the U.S.O.E. To date, this sub-contracted section of the report has not been received by the Bristol Career Education Program. It, therefore, has been omitted until such time as the properly prepared document can be inserted.

Conclusions, Implications, and Recommendations:

On the elementary level, it is recommended to review the practicality of having one specialist service the twenty elementary schools that will be involved with the program next year. It is also recommended that the elementary specialist develop a closer affiliation with the Supervisor of Elementary Education and his staff. An additional recommendation is to develop more extensive in-service training for teachers.

On the junior high level, we have met all of the goals and objectives as set up by the original proposal to some degree. A number of these goals have been met very successfully, while others only minimally. It is felt at this point that in order for the seventh and eighth grade portion of the program to make a meaningful impact on the educational system a greater degree of coordination will have to be attained. Up to the present, each school and each teacher in each school has chosen whether or not to participate in the program; and in a manner of their own choice. This has led to a high degree of creativity as anticipated. It is time to bring these ideas into a series of packaged lessons; completely integrated into the existing seventh and eighth grade curriculum.

We would recommend that each teacher in the four major subjects be required to do at least three Career Education activities with their classes next year. These lessons will be produced by the subject coordinator and the Career Education person jointly. The lessons will form a complete package and be stored in the Career Resource Center. This production of activities will be constantly evaluated and updated; and offered to all other teachers as practical demonstrations.

We would also propose an expansion of the Shadow Exploration Day Program to involve all eighth grade students. Obviously, this will be done with the cooperation of the junior high guidance counselors.

On the junior high level, we recommend that each major subject will undertake three Career Education activities per level. Also, that we begin work with other subjects to also undertake three Career Education activities. And, that we develop other activities to give teachers a choice of activities to use.

Body of the Report (Continued)

Also on the junior high level, we recommend that the activities being used be evaluated and modified if they need be. And, finally, that we involve all eighth grades in the Shadow Exploration Day Program.

On the high school level, it is recommended to develop a new scheduling process for the Community Resource Aide to work within. It seems as the Career Education Program continues to grow, the time allocated to this position has now become insufficient. Overall the initial set of needs and goals on which the project was first funded have proved to be realistic and beneficial to the Bristol Public School System. The involvement in this program has developed a better and more meaningful educational experience for the students of the project sites. Too, the involvement produced a positive base of experiences which in turn founded expertise, materials, awareness, and support of the philosophies and concepts of career education on which further direction and expansion can build.

There is strong supportive data which conclude that the community of Bristol supports the concept of career education. Strong cooperative relationships between the business community and the schools have been very helpful in implementing the full concept of career education.

In summary, we can remark that the Bristol Career Education Program has continued to create a favorable and meaningful impact on the Bristol Public School System and will leave its mark for a long time to come.

Robert J. Edmondson

Robert J. Edmondson
Director, Career Education

June 30, 1975

APPENDIX

Exploration Day Sites	Number of Observations Made						
	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
I. AGRI-BUSINESS & NATURAL RESOURCES							(4)
BRISTOL NURSERIES, INC.							
Plant taxonomist			1				1
ERICSON FLORISTS							
Florist		1			1		2
MOUNTAIN VALLEY EQUESTRIAN CENTER							
Horse groomer & boarder			1				1
II. BUSINESS AND OFFICE							(40)
BERTRAND ROULEAU CPA							
Accountant		6					6
BRISTOL BOARD OF EDUCATION							
Secretary					1		1
Switchboard operator	1	1					2
Typist			1				1
BRISTOL CITY HALL - Circuit Court 17							
Court stenographer		2					2

Exploration Day Sites	Number of Observations Made						
	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
BRISTOL SAVINGS BANK							
Financier			1				1
Teller			1				1
BURTON CARLSON, Atty. at Law							
Legal secretary		1					1
CAREER EDUCATION OFFICE							
Secretary		1	2				3
CONNECTICUT BANK & TRUST							
Teller	1						1
FLETCHER-TERRY CO.							
Executive secretary		3					3
FUREY, DONOVAN & HEIMAN							
Legal secretary	1	4	2				7
ROY MACHINE & TOOL							
Executive secretary	1	2					3
STEPHEN'S WORLD OF WHEELS							
Computer programmer			3				3
Data Processor	2						2

Exploration Day Sites	Number of Observations Made						
	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
SUPERIOR ELECTRIC							
Electronic computer technician		3					3
III. COMMUNICATIONS & MEDIA							(11)
AMERICAN CAN CO.							
Printer		1					1
CHANNEL 30 Tom Monahan							
Television broadcaster				1		1	2
CPTV							
Television electronics			1				1
SNET							
Telephone electronics		1					1
TUNXIS ELECTRONICS							
Radio & TV repairman	1	1					2
WBIS							
Broadcaster	1		1				2
Disc jockey			1				1
Radio technician		1					1

Exploration Day Sites	Number of Observations Made						
	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
IV. CONSTRUCTION							(14)
CL&P							
Lineman		2	1				3
COUTURE CONSTRUCTION							
Building contractor		1					1
KENNETH E ALLEN							
Architect	1						1
LEPORE'S CIVIL ENGINEERS							
Civil engineer			1				1
J.L. MURDOCK							
Electrician	1	1					2
M&M HEATING							
Sheet metal worker	1						1
PETOSA CONSTRUCTION							
Carpenter		1					1
SAUCIER ELECTRIC CO.							
Electrician		1					1

Number of Observations Made

Exploration Day Sites	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
SCHAFFER PLUMBING CO.							
Plumber	1						1
VILLAGE CABINET SHOP							
Cabinet maker		2					2
V. CONSUMER & HOMEMAKING							(7)
ANTHONY"S RESTAURANT							
Short order cook		1			1		2
FOOD MART							
Cashier		3					3
Supermarket manager		1					1
HARVEST BAKERY							
Baker		1					1
VI. ENVIRONMENT							(8)
BARNES NATURE CENTER							
Naturalist			2			1	3
CT. FOREST & PARK ASSOCIATION							
Forester		2					2

Exploration Day Sites	Number of Observations Made						
	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
DEPARTMENT OF ENVIRONMENTAL PROTECTION							
Conservation officers		3					3
VII. FINE ARTS & HUMANITIES							(7)
R.E. DEFOSSES							
Photographer		7					7
VIII. HEALTH							(84)
32. AMITY DRUG							
Pharmacist		1					1
BRISTOL HOSPITAL							
Bacteriologist	1						1
LPN & RN	3	5	8				16
Medical lab technician	1	1	1				3
Medical records			1				1
Mental health worker	2		4				6
Pathologist	1		2				3
Physical therapist	1		2				3

Number of Observations Made

Exploration Day Sites	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
Physician			4				4
Radiologist	1						1
Surgical Technician			3				3
X-ray Technician	2		2				4
CT. MEDICAL LABORATORY							
Medical lab technician		2					2
DR. CORATOLA							
Dental hygienist		2					2
Dentist		2					2
FORESTVILLE NURSING CENTER							
Nurse				2	1		3
Physical therapist		2	1				3
DR. MCALLISTER							
Dental assistant	1						1
Dental hygienist	1	1					2
Dental technician	1						1
Dentist		1					1

Exploration Day Sites	Number of Observations Made						
	Central	Eas tern	St. Paul's	Memorial B oulevard	St. Ann's	West Woods	Totals
DR. RAFANIELLO							
Dental technician		2					2
RED CROSS							
Office work		2					2
DR. SPEAR							
Podiatrist			1				1
VETERINARY CLINIC OF W. HARTFORD							
Veterinarian		1	2				3
VETERINARY MEDICAL ASSOCIATES							
Veterinarian	1		2				3
VISITING NURSES							
RN	1	2					3
WATERBURY EASTER SEAL REHABILITATION CNTR.							
Physical therapist		4					4
WHEELER AFFILIATES							
Nursery/Day care center aide			1				1
Occupational therapist		2					2
Worker with retarded children		1					1

Exploration Day Sites	Number of Observations Made						
	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
YOUNG AMBULANCE SERVICE							
Ambulance driver/attendant		1					1
IX. HOSPITALITY AND RECREATION							(4)
BRISTOL GIRL's CLUB							
Recreation director	1						1
CHIPPANEE GOLF CLUB							
Chef		2					2
X. MANUFACTURING							(7)
KEYSTONE INDUSTRIES							
Welder	3						3
Woodworker						1	1
NATIONAL PLASTICS							
Plastics worker			1				1
TRIPLE A SPRINGS							
Springmaker		1	1				2

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Exploration Day Sites	Number of Observations Made: Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
XII. MARKETING AND DISTRIBUTION							(5)
CONTAC ADVERTISING							
Commercial artist		3	1				4
DOROTHY'S							
Salesgirl		1					1
XIII. PERSONAL SERVICES							(12)
AVON PET & TACK SHOP							
Pet Shop owner		1					1
HANOVER SCHOOL OF MODELING							
Model		1					1
FARMINGTON VALLEY AQUARIUM							
Tropical fish retailer		3					3
LAND'S							
Men's clothing groomer		2					2
NATIONAL ACADEMY OF HAIRDRESSING							
Beautician	1	1					2
Hairdresser		3					3

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Exploration Day Sites	Number of Observations Made						
	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
XIV. PUBLIC SERVICES							(54)
BEACH & CALDER							
Lawyer	1		2				3
BETH ISRAEL NURSERY SCHOOL							
Nursery school teacher		2					2
BRISTOL DAY CARE CENTER							
Day care center aide		3					3
BRISTOL FIRE DEPARTMENT							
Fireman	1	1					2
BRISTOL POLICE DEPARTMENT							
Policewoman	2	1	1				4
BRISTOL POST OFFICE							
Mailman		1					1
ADULT PROBATION OFFICE							
Probation officer		1					1
CENTRAL HIGH SCHOOL							
History teacher		1	1				2

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Exploration Day Sites	Number of Observations Made						
	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
MISS CLAIRE'S NURSERY SCHOOL							
Nursery school teacher		1					1
CT. STATE EMPLOYMENT OFFICE							
Employment office worker		1					1
CT. STATE POLICE							
State policeman		1					1
EASTERN HIGH SCHOOL							
History teacher	1						1
Music teacher	1						1
Physical education teacher	1						1
EDGEWOOD SCHOOL							
Elementary teacher	1	1	4				6
HANRAHAN, GRABOWSKI & HAYES							
Lawyer			1				1
HOMEMAKER SERVICE OF BRISTOL							
Health aide		2					2

Exploration Day Sites	Number of Observations Made						
	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
IVY DRIVE SCHOOL							
Special education teacher (retarded)		2					2
JUVENILE CT./ DEP'T. OF CHILDREN & YOUTH SERVICES							
Case worker		1	1				2
MERRIAM-GRADY PRESCHOOL							
Nursery school teacher (Montessori)		2					2
MOUNTAIN VIEW SCHOOL							
Kindergarten teacher		2					2
PATTERSON SCHOOL							
Special education teacher (blind)		1					1
ST. PAUL'S DAY CARE CENTER							
Day care center aides		2					2
ST. PAUL'S HIGH SCHOOL							
Physical education teacher		2					2
SOUTH CHIPPENS HILL SCHOOL							
Special education teacher		1					1

Exploration Day Sites	Number of Observations Made						
	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
SOUTH SIDE SCHOOL							
Kindergarten teacher		2					2
Speech pathologist			1				1
TERRY NURSEY SCHOOL							
Nursey school teacher			2				2
THOMASTON POLICE DEPARTMENT							
Patrol work			1				1
WATERBURY REGIONAL CENTER							
Teacher of mentally retarded children			1				1
XV. TRANSPORTATION							(16)
BRADLEY INTERNATIONAL AIRPORT							
Aviator	1						1
Eastern Airlines ticket agent		2					2
THE COMPLETE RIDER							
Motocycle salesman & repairman		2					2
H&H MOTORS							
Auto mechanic		2					2

Exploration Day Sites	Number of Observations Made						
	Central	Eastern	St. Paul's	Memorial Boulevard	St. Ann's	West Woods	Totals
MOTOR SPORTS LIMITED							
Motorcycle repairs		1					1
STEPHAN'S WORLD OF WHEELS							
Auto body repairman		1					1
Auto mechanic				1			1
TOMASSO							
Truck driver		3				1	4
TREADWAY TRAVEL SERVICE							
Travel agent		1					1
TRUDON FORD							
Auto mechanic		1					1
TOTALS	43	147	71	4	4	4	273

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FIELD TRIPS

	Central	Eastern	St. Paul's	Collins	Gee on Hills	Hubbell	Jay Dalton	Memorial Boulevard	Northwest	Northeast	O'Connell	St. John's	St. Ann's	St. Anthony's	St. Stephen's	Stafford	West Woods	West Woods	Mountain View	Totals
I. AGRI-BUSINESS & NATURAL RESOURCES																				(2)
MRS. WARGO																				
Farm				1																1
UNIVERSITY OF CONNECTICUT																				
Farm															1					1
II. BUSINESS & OFFICE																				(1)
SUPERIOR ELECTRIC																				
Computer operations	1																			1
III. COMMUNICATIONS & MEDIA																				(11)
BRISTOL PRESS					1		2	1			1	2			1				2	10
WOLF PRINTING COMPANY		1																		1
V. CONSUMER AND HOMEMAKING																				(27)
MACDONALD'S	1	1						2												4
RUSTLER'S																				
Short order restaurant		2																		2
SINGER'S, TAB'S, CONSUMER SALES																				
Small, retail stores		3																		3

FIELD TRIPS	Central	Western	St. Louis's	Collen K-6	Green Hills K-6	Mitchell K-6	Jay Drive K-6	Memorial Boulevard	Northwest K-6	O'Connell 7-8	St. Ann's K-6	St. Charles 7-8	St. Stephen's K-6	Stafford 7-8	West Woods K-6	West Woods 7-8	Mountain View	Totals
COTTAGE BAKERY																		
Bakery									2									2
FOOD MART																		
Grocery Store	1	3						1										4
NASSIF'S																		
Furniture Store	1	1																2
J.C. PENNEY'S - BRADLEES																		
Discount Store		2																2
PETIT'S - STOP & SHOP - COPACO																		
Grocery Store		3																3
REYMOND'S																		
Bakery	1	1								1							1	4
VI. ENVIRONMENT																		
CITY OF BRISTOL																		
Water Filtration Plant						1			1									2
Sewage Treatment Plant				1										+				1

FIELD TRIPS	Central	Eastern	St. Paul's	Chilton K-6	Hebron K-6	Hebron 7-8	New Britain K-6	Hospital Boulevard	Northwest K-6	Northwest 7-8	McConnell K-6	St. Mark's K-6	St. Martin K-6	St. St. Anthony's K-6	Stafford K-6	West Woods K-6	West Woods 7-8	Mountain View	Totals
VII. FINE ARTS AND HUMANITIES																			(1)
WADSWORTH ATHENEUM																			
Museum											1								1
VIII. HEALTH																			(2)
NEWINGTON CHILDREN"S HOSPITAL		1																	1
WHEELER AFFILIATES		1																	1
X. MANUFACTURING																			(7)
ASSOCIATED SPRINGS																			
Springmakers							3												3
NEW DEPARTURE																			
Ball bearing factory							2												2
PRATT & WHITNEY																			
Aircraft manufacturer		1																	1
SUPERIOR ELECTRIC																			
Electrical components manufacturer							1												1

FIELD TRIPS

	Green Hills Rosbell K-6	Low Relay K-6	Memorial Boulevard	Northeast Jr. High	Northeast Sr. High	Northeast Vo-Tech	Oil Capital 7-8	St. Isaac's K-6	St. Isaac's 7-8	St. Mathew's K-6	St. Mathew's 7-8	Stafford K-6	Walt Woods K-6	West Woods 7-8	Edgewood	Totals
XIV. PUBLIC SERVICES																(34)
AUTO ISAAC, NURSING HOMES			1													1
EMERGENCY DAY CARE CENTER			1													1
CHISHOLM CITY HALL				1									1			3
CHISHOLM FIRE DEPARTMENT				2		2										4
CHISHOLM POLICE DEPARTMENT				1							1					2
CHISHOLM PUBLIC LIBRARY								3		2				2	3	10
CHISHOLM CAMPUS SCHOOL								2								2
CH. BANK & TRUST										1						1
CH. ENTERTAINMENT OFFICE			1													1
KAUFMAN LIBRARY									1							1
U.S. POST OFFICE				2	1	1	1				1			1			1	8
XV. TRANSPORTATION																(1)
CHISHOLM MUNICIPAL AIRPORT																
Air Traffic Control			1													1
TOTALS	5	24	5	8	4	3	14	2	6	3	2	1	3	1	2	1	4	W3 BW1	87

SPEAKERS	Central	Eastern	St. Paul's	Hingham K-6	Cushing K-6	Edgewood K-6	Kimball K-6	Ivy Drive K-6	Jennings K-6	Memorial Elem.	Hing. Middl K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Southern K-6	S. Chiswick Hill	West Woods K-6	West Woods 7-8	Totals
II. BUSINESS AND OFFICE																					(22)
ASSOCIATED SPRING CORP.																					
Secretary/typist		1																			1
BRISTOL FEDERAL SAVINGS AND LOAN																					
Bank teller			1																		1
BRISTOL SAVINGS BANK																					
Banker																			1		1
Executive secretary		1																			1
Purchasing agent		1																			1
BUDROUGHS																					
Computer programmer		1																			1
CT. BANK AND TRUST																					
Bank teller		1																			1
DENING & LUSCOMB																					
Real estate agents	1																				1
FOXBORO'S																					
Credit manager		1																			1

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callan K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mt. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-9	Totals
ERNST & ERNST																					
Accountant		1																			1
FLETCHER-TERRY CO.																					
Secretary/typist		1																			1
H&R BLOCK																					
Tax consultant		1																			1
MARIA GARCIA																					
Bi-lingual secretary		1																			1
MERRILL, LYNCH, PIERCE, FENNER & SMITH																					
Stockbroker			1																		1
NEW YORK LIFE INSURANCE CO.																					
Insurance agent		3																			3
PECK, BARNARD & OLMSTEAD, INC.																					
Insurance agent		1																			1
PUTNAM, COFFIN & BURR																					
Stockbroker		1																			1

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callan K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Wm. Vibert K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-8	Totals
SNET																					
Clerical worker			1																		1
UNITED BANK & TRUST																					
Banker										1											1
ROBERT J. VICINO AGENCY, INC.																					
Real estate agent		1																			1
III. COMMUNICATIONS & MEDIA																					(16)
BRISTOL PRESS																					
News reporter	1	1								1											3
Photographer		1																	1		2
CT. SCHOOL OF BROADCASTING																					
Radio & TV announcer		1																			1
HARTFORD COURANT																					
News reporter	1																				1
Journalist		2																			2

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SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callen K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mt. Tom K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Shaffer K-6	S. Chapman Hill	West Woods K-5	West Woods 7-8	Totals
TUNXIS ELECTRONICS																					
Radio & TV repairman	2	1																			3
WBIS																					
Radio announcer			1																1		2
WTIC - CHANNEL 3																					
TV Broadcasters	2																				2
IV. CONSTRUCTION																					(8)
KENNETH ALLEN																					
Architect		1																			1
CARPENTER'S UNION																					
Carpenter		1																			1
CL&P																					
Splicing foreman										1											1
JOSEPH COUTURE-BUILDER & REAL EST.																					
Building contractor		1																			1

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Calhoun K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mt. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-8	Totals
ROMEO DESJARDINS																					
Carpenter		1		1																	2
LICKWAR & MURDOCK																					
Electrician		1																			1
MUSUMANO CONSTRUCTION																					
Carpenter		1																			1
V. CONSUMER & HOMEMAKING																					(6)
COTTAGE BAKERY																					
Baker		1											2								3
FOOD MART																					
Cashier		1																			1
HOMEMAKER"S SERVICE OF BRISTOL																					
Home economist		1																			1
PETEY BUCK"S GRINDERS																					
Short order cook		1																			1
VI. ENVIRONMENT																					

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callon K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mt. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-8	Totals
VI. ENVIRONMENT																					31
BARNES NATURE CENTER																					
Naturalist																				1	1
BRISTOL BRASS																					
Air pollution specialist					1																
CT. ENERGY COMMISSION																					
Energy consultant																				1	1
CT. FOREST & PARK ASSOCIATION																					
Secretary-forester		2																			2
HEALTH DEPARTMENT, CITY OF BRISTOL																					
Pollution specialist	1																				1
TUNXIS COMMUNITY COLLEGE																					
Metoerologist		1																			1
WATER FILTRATION PLANT																					
Water pollution specialist					1																1
BRIAN SAUCIER																					
Herpetologist																				1	1

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callen K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Meadowdale Blvd.	Mt. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-8	Totals
VII. FINE ARTS & HUMANITIES																					(5)
CHRIS LYNCH																					
Candlemaker																	1				1
THE GALLERY																					
Musician	1																				1
GLO SESSIONS																					
Artist		1																			1
R.E. DEFOSSES																					
Photographer	1	1																			2
VIII. HEALTH																					(49)
BICYCLE SAFETY INSTRUCTOR				ALL SCHOOLS																	17
BRISTOL HOSPITAL																					
Inhalation therapist		1																			1
LPN & RN	2																				2
Mental helath worker		1																			1
Pediatrician		1						1													2

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SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Cullen K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	[illegible] K-6	Northeast K-6	Northeast 7-9	St. Ann's K-6	St. Ann's 7-9	St. Stan's 7-9	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-9	Totals
Physical therapist		1	1																		2
Physician		1																			1
X-ray technician		2														1					3
CENTRAL DRUG & SURGICAL SUPPLY																					
Pharmacist	1	1					1												1		4
FORESTVILLE NURSING CENTER																					
Nurses aide		1																			1
MRS. MARCOTTE																					
Dental hygienist								1													1
MT. SINAI HOSPITAL																					
Hospital auxiliary speaker		1																			1
Medical social worker		1																			1
NURSING CARE CENTER OF BRISTOL																					
Dietician		1	1																		2
RED CROSS																					
First Aid instructor							1					1						1	1		3

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SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callen K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mt. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-8	Totals
TUNXIS COMMUNITY COLLEGE																					
Chemist			1																		1
UCONN MEDICAL CENTER																					
Veterinary researcher		1																			1
VISITING NURSES																					
RN										1										1	2
WHEELER AFFILIATES																					
Occupational therapist		2																			2
Psychologist		1																			1
IX. HOSPITALITY & RECREATION																					(3)
COOKE'S TAVERN																					
Restaurant manager		1																			1
EL CHARRO DE MEXICO																					
Restaurant manager								1													1
NEW CAMBRIDGE INN																					
Restaurant manager		1																			1

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callan K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mrs. Clark K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chipione Hill	West Woods K-6	West Woods 7-8	Totals
X. MANUFACTURING																					(15)
BRISTOL BRASS																					
Draftsman		1																			1
Metallurgist	1																				1
Tool & die maker		1					1				1			1					1		5
Union speaker		1	1																		2
FAFNIR'S																					
Machinist	1																				1
Tool & die maker		1																			1
FLETCHER-TERRY CO.																					
Industrial designer	1																				1
MR. KURACZ																					
Speaker on metric system														1							1
PORTER SCHOOL OF DESIGN																					
Designer	1																				1

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callon K-6	Edgewood K-6	Hobbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mtn. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-8	Totals
SUPERIOR ELECTRIC																					
Electrical engineer		1																			1
UAW																					
Union speaker	1	1																			2
WASLEY PRODUCTS																					
Personnel manager	1																				1
XII. MARKETING & DISTRIBUTION																					(11)
AVON PRODUCTS																					
Professional saleswoman			1																		1
CONTAC ADVERTISING																					
Commercial artist							1														1
DOROTHY'S																					
Clothing buyer	1																				1
Retailer & merchandiser		1	1																		2
FOOD MART																					
Supermarket manager		1																			1

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callen K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mt. View K-6	Northeast K-6	Northeast 7-9	St. Ann's K-6	St. Ann's 7-9	St. Stan's 7-8	Stafford K-5	S. Chippens Hill	West Woods K-6	West Woods 7-9	Totals
PETIT'S SUPERMARKET																					
Supermarket manager	1	2																			3
PRO-LITHO PRINTING																					
Printer	1																				1
TONY CALBI'S																					
Sole proprietor		1																			1
XIII. PERSONAL SERVICES																					(15)
ANDY'S BARBER SHOP																					
Barber		2																			2
FRIGON FUNERAL HOME																					
Funeral director	1	1																			2
HANOVER SCHOOL OF MODELING																					
School director		1																			1
JIM'S BARBER SHOP																					
Barber		1																		1	2
LAND'S																					
Men's groomer		1																			1

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callen K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mrs. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-8	Totals
MAYNARD'S BRIDAL CORNER																					
Bridal consultant		1																			1
MRS. GARAM																					
Dog trainer										1											1
NATIONAL ACADEMY OF HAIRDRESSING																					
Hairdresser/beautician		1	1																		2
ST. MATTHEW'S CHURCH																					
Priest		1																			1
UNITED ASBURY METHODIST CHURCH																					
Marriage counselor		1	1																		2
XIV. PUBLIC SERVICES																					(45)
ADULT PROBATION OFFICE																					
Probation officer		1																			1
ARMY RECRUITING CENTER																					
Army recruiter	1																				1

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SPEMERS	Central	Eastern	St. Paul's	Bingham K-6	Callen K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Sch. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-8	Totals
ATTORNEY CARLSON																					
Lawyer	2	1																			3
ATTORNEY CAPBACIK																					
Lawyer																				1	1
ATTORNEY MATTIOLI																					
Lawyer (criminal)		1																			1
BETH ISRAEL NURSERY SCHOOL																					
Nursery school teacher		1																			1
BRISTOL COMMUNITY ORGANIZATION																					
Social workers		3																			3
BRISTOL BOARD OF EDUCATION																					
Intermediate helping teacher		1																			1
School social worker		2																			2
BRISTOL FIRE DEPARTMENT																					
Fireman									1												1
BRISTOL PARK DEPARTMENT																					
Recreation worker	1	1																			2

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callon K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mt. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	SE. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-8	Totals
BRISTOL POLICE DEPARTMENT																					
Policeman									1												1
Policewoman		1																			1
BRISTOL PUBLIC LIBRARY																					
Librarian	1																				1
CCSC																					
Math professor	1																				1
CITY OF BRISTOL																					
Dog warden		1																			1
Public defender		2																			2
CT. CORRECTIONAL INSTITUTION																					
Assistant director						1															1
CT. STATE WELFARE																					
Adoption agency representativ		1	1																		2
Social worker	1	2																			3
FAMILY COUNSELING SERVICES																					
Marriage counselor		1																			1
Family counselor		2																			2

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callen K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mt. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-8	Totals
FUREY, DONOVAN & HEIMAN																					
Lawyer			1																		1
HANRAHAN, GRABOWSKI & HAYES																					
Lawyer (business)		1																			1
HARTFORD FAMILY COURTS																					
Social worker		1																			1
HEAD START PROGRAM																					
Program director		1																			1
MERRIAM-GRADY PRESCHOOL																					
Montessori nursery teacher		2																			2
NAACP																					
Civil rights speaker			1																		1
REPUBLICAN PARTY																					
Politician																			1		1
U.S.A.F.																					
Air Force recruiter		1																			1

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callen K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jennings K-6	Memorial Blvd.	Mt. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippewa Hill	West Woods K-6	West Woods 7-8	Totals
B.F.M.																					
Chief	1	1																			2
Navy recruiter		1																			1
XV. TRANSPORTATION																					(10)
MR. BORG																					
Pilot (recreational)									1												1
H&H MOTORS																					
Auto repairman		1																			1
MOTORSPORTS LIMITED																					
Motorcycle sales and repairs															1					1	2
NESCI'S TRAVEL SERVICE																					
Travel agent																			1		1
SPECTOR FREIGHT SYSTEMS																					
Long distance truck driver	1	2																			3
Despatcher	1																				1
STEPHEN'S WORLD OF WHEELS																					
Auto mechanic		1																			1

SPEAKERS	Central	Eastern	St. Paul's	Bingham K-6	Callon K-6	Edgewood K-6	Hubbell K-6	Ivy Drive K-6	Jenkins K-6	Memorial Blvd.	Mtn. View K-6	Northeast K-6	Northeast 7-8	St. Ann's K-6	St. Ann's 7-8	St. Stan's 7-8	Stafford K-6	S. Chippens Hill	West Woods K-6	West Woods 7-8	Totals
TREADWAY TRAVEL SERVICE																					
Travel agent		1																			1
TOTALS	33	109	15	2	3	2	5	4	4	5	2	2	3	3	2	2	2	2	8	8	216

Bristol Public Schools

FEB 25 1975

DR. WILLIAM F. ROWE
SUPERINTENDENT OF SCHOOLS

MR. GEORGE WM. BOUNTRESS
ASSISTANT SUPERINTENDENT - INSTRUCTION
MR. CONSTANT W. BLUM
ASSISTANT SUPERINTENDENT - PERSONNEL
MR. JOHN E. SMITH
BUSINESS MANAGER

BRISTOL, CONNECTICUT 06010

February 18, 1975

Mr. Robert J. Edmondson
Director, Career Education Program
Bristol Public Schools
Bristol, Connecticut 06010

Dear Mr. Edmondson:

Congratulations to you and the many staff members who worked so ardently to develop the three curriculum guides for the Career Education Program. It certainly was a monumental task.

I have skimmed over the guide to grade the contents. I sincerely congratulate all participants for the structure and instructional content in each category. I believe the job was exceptionally well done.

There is no doubt about the dedication and the hard work of the [illegible] as to the instructional content and to the supplemental papers. They have created an instrument which will be of great value not only to the teachers who will use it but also to the students who will profit from the program as developed in the guides.

Usually I am at a loss for words when I want to express my appreciation for excellent work. I must confess that this is one of those rare times when excellence and quantity simply overwhelm me.

My congratulations are most cordially expressed, however, you may be sure.

Sincerely,

George Wm. Bountress
Assistant Superintendent
For Instruction

GWB:jb

cc: Dr. William F. Rowe

70

BRISTOL CHAMBER OF COMMERCE

81 MAIN STREET
BRISTOL, CT. 06010
PHONE (203) 583-4111

MAR 4 1975

March 3, 1975

Robert Edmondson
Bristol Public Schools
237 Wolcott Street
Bristol, CT 06010

Dear Bob:

It was a pleasure to see you at our Business - Industry - Education Seminar Thursday evening. As stated at the meeting, we are most gratified by the emphasis placed on Career Education in the Bristol School System.

I hope that the good lines of communication that have been developed through our regular committee activities and especially through our annual B.I.E. Seminar will continue.

We look forward to seeing you in future meetings.

Sincerely,

Walter R. Sonstroem, Vice-President
Business Industry Education Division

WRS/lrg

71

JAN 15 1975

January 14 1975
632 Key St
Butte, Mon

Dear Mr. Lamontagne,

In the first minutes of this academic year comes to a close, I feel I must write and tell you of my sincere pleasure and satisfaction with the broad curriculum being run by at Butte Central High School.

I have been teaching Economics and working in Butte for the past ten years or so and I must admit I have never received as much actual help on my everyday classroom teaching as I have from Miss Kathy Quinn, Career specialist here at B.C.H.S.

Miss Quinn has become "the Classroom teacher's right hand woman." We had been in the beginning of the semester and worked out an excellent program of career speakers. My students were fortunate enough to hear fifteen speakers from the "outside" in all fields.

Kathy has also supplied me

with bright prospects relevant to careers in the area of the social sciences.

My classes have improved. The students have added a fund of variety, much knowledge and expertise in their talks. According to my students, "The classroom has come alive." They have been enamored with the speakers, resources, their careers and their talks.

I look ground with anticipation to the second semester as they and I are working on a similar program for the rest of the year.

Believe me, this teacher is grateful for the help and co-operation the students are appreciative. From all of us to all of you in Career Education, we say thank you and keep up the good work.

Sincerely,
Joan Gestaldo

73

THE FLETCHER-TERRY COMPANY

SPRING LANE • FARMINGTON, CONNECTICUT 06032

TERRY B. FLETCHER
PRESIDENT

March 12, 1975

Mr. Robert Edmondson
237 Wolcott Street
Bristol, CT 06010

Dear Mr. Edmondson:

I have participated many times in Career Day Programs. As an employer, I realize the great need for educating the students to the needs and skills required to get the skilled and unskilled jobs which are available throughout their community.

It is my sincere hope that we continue to offer this Career Education Program to our community.

Sincerely,

TBF/av

79

UNITED AUTOMOBILE · AEROSPACE · AGRICULTURAL IMPLEMENT WORKERS of AMERICA (UAW)

UAW

INTERNATIONAL UNION

BRISTOL BRASS LOCAL 1500
247 PARK STREET
BRISTOL, CONNECTICUT
14

March 13, 1975

Robert Edmondson Dir.
Career Education
Bristol Public Schools

Dear Bob:

I wish to take this opportunity to express our feelings, as a Labor Organization, of having the chance to participate in Career Education Programs in the public schools. Through the combined efforts of Frank Dolce, Joan Atkinson and Kathy Quinn, the UAW Central Area Community Action Program, works.

All to often, to many, Unions and Strikes are synonymous. This could bring about a new image in the eyes of the public. We hope this Career Education program continues to grow and expand in the hopes of making this a better community for all.

Sincerely,
Mike Busha
Mike Busha
Coordinator for

United Auto Workers
Central Area
Community Action Program
Fred Caracciolo, President

75

City of Bristol

Bristol, Connecticut 06010

BRISTOL YOUTH COMMISSION

March 6, 1975

Mr. Robert Edmonson
Director
Bristol's Career Education

Dear Bob,

In behalf of the Bristol Youth Commission Office I would like to go on record of supporting Bristol's Career Education Program.

Career Education programs are needed in communities like Bristol to help expose students to different occupations in classroom study and on prospective job sites.

Placement is another important aspect of Career Education. In Bristol the Career Education Program has set up a high school placement program with the cooperation of local industry and the Chamber of Commerce.

In its short existence it is my impression that the Career Education Program has a definite place in the Community of Bristol.

Sincerely,

Arthur K. Hoge Jr.

Arthur K. Hoge Jr.
Co-ordinator of Youth Services

76

BOARD OF EDUCATION
985 FARMINGTON AVENUE
P. O. BOX 450
BRISTOL, CONNECTICUT 06010

BRISTOL PUBLIC SCHOOLS

MAR 12 1975

March 10, 1975

Mr. Robert Edmondson, Director
Career Education
Wolcott Street
Bristol, Connecticut 06010

Dear Bob:

I want to commend you and your staff in Career Education for its outstanding efforts in the Jr. High Schools, both public and parochial.

Mr. Angelo Llopis has been extremely helpful and cooperative in implementing the Career Education program into the schools' curriculum. The programs are creative and functional.

After two years, Career Education has become vital to our schools and its curriculum. Again, congratulations and continued success.

Sincerely,

A. Lewis Beatson,
Guidance Director
Jr. High Schools

ALB/sdk

77

BRISTOL CHAMBER OF COMMERCE

81 MAIN STREET
BRISTOL, CT 06010
PHONE (203) 589-4111

March 11, 1975

Mr. Robert Edmondson
237 Wolcott Street
Bristol, CT 06010

Dear Mr. Edmondson:

Our recent meetings with the school administrators prompts me to write at this time and express our concern that you will be able to continue and expand the excellent Career Education Program that we have in Bristol.

We are most pleased with the response given to the Spring Technology Course. The graduates of this course are filling a very definite need for semi-skilled personnel in our highly technical community. We would hope that similar programs can be developed in other areas where technical skills are needed.

Any effort that you can make in this direction has our wholehearted support.

Please be sure to call on us, if we can assist in any way.

Sincerely,

Terry B. Fletcher
President

TBF/av

78

SERVING THE BUSINESS, CIVIC, AND CULTURAL LIFE OF BRISTOL, CONNECTICUT

JUN 2 1975

Miss Kathleen Newpeck
Mrs. Deborah Bombanti
West Woods School
Charles St. Ext.
Bristol, Connecticut
May 23, 1975

Mr. Bob Edmonson
Career Education
Bristol Board of Education
Box 450
Bristol, Connecticut

Dear Sir:

On behalf of the children, as well as ourselves, we would like to express our appreciation for the funding of our trip to the University of Connecticut. It was a very rewarding experience for all those who participated.

We will forward to continued involvement in the Career Education program with the coming school year.

Again, our appreciation.

Sincerely,

Deborah Bombanti

Kathleen Newpeck

BRISTOL PUBLIC SCHOOLS BRISTOL, CONNECTICUT

APR 22 1975

April 18, 1975

Dear Miss Quinn:

I recently received a letter of commendation from Joseph M. Bertotti, Manager of Corporate Educational Relations for General Electric, in which he lauded you for your leadership role in Career Education. He also enclosed a very nice photograph of your being presented with an award. Perhaps you will want to keep it for your memoirs.

Thank you for bringing credit to yourself, your school department, and community.

Sincerely,

Dr. William F. Rowe
Superintendent of Schools

COPY

Miss Kathleen Quinn
Bristol Eastern High School
Bristol, Connecticut 06010

WFR:lsp
Copies to: Mr. Robert Edmondson
Mr. Jon R. Matt

80

St. Ann School
241 West Street
Bristol, Connecticut 06010

April 15, 1975

APR 17 1975

Mr. Robert J. Edmondson
Director, Career Education Program
Bristol Board of Education
985 Farmington Avenue
Bristol, Connecticut 06010

Dear Mr. Edmondson:

We would like to express our deep gratitude for funding our Career Education trip to the Atheneum. We learned some of the careers involved in the up-keep of the museum, along with the many different kinds of art forms. We were pleased with this trip and we found it very enlightening. Besides this trip we are very appreciative of the times Mr. Llopis came to our school to help us with our careers and with wood working. Thank you.

Sincerely yours,
8th grade class of
Saint Ann's School

81

Date March 18, 1975

BOARD OF EDUCATION
INTEROFFICE COMMUNICATION

MAR 25 1975

To Mr. Robert J. Edmondson, Director From Dale H. Wentzel

Re: Career Education Curriculum Guide for Grades K-6

I have completed reviewing the Career Education Curriculum Guide for Grade K-6. I am pleased with the direction the program is taking and feel that the instructional activities included in the guide can be helpful to the teachers and students in our regular curriculum areas.

The guide represents the efforts of many people and should prove to be an excellent resource for teachers at the K-6 level.

DHW/sdk

82

MAR 25 1975

Dear Mr. Edmondson,

I thank you for coming to Edgewood School recently and giving us an evening of your time!

I apologize for the poor attendance, it's a shame that more parents don't realize the fine work that's being done in the Career Ed. Program.

It was an excellent presentation and again, I thank you.

Sincerely,
Pat Lacouture
President
Edgewood P.T.O.

Dear Mr Cameron,

Just a little note to thank you, Mrs Rice & Mr Shapiro for your very interesting and informative slide and discussion program.

It was very enlightening.

We wish you continued success in this very important area of education.

Our sincere thanks.

Anita Lacaiz
Secretary St. Ann's
Parent Educator Assoc.

MAR 25 1975

84

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION
WASHINGTON, D.C. 20202

April 2, 1975

APR 7 1975

Dr. Robert J. Edmondson, Director
Career Education
Bristol Public Schools
985 Farmington Avenue
P.O. Box 450
Bristol, Connecticut 06010

Dear Bob:

I found your letter of March 6, 1975 after you were in the office recently to deliver materials to me personally. I want to take this opportunity to follow up just to let you know how much I appreciate both your letter and the materials. I also appreciate your willingness to take time out of your schedule to visit with me for a while. I hope very much that we can follow up on that visit in terms of other contacts here in Washington.

I will also, of course, be very, very interested in any hard data you can come up with for evaluation of career education.

Finally, I note your request with respect to my possible availability for visiting in Bristol. As I told you in the office, I'll be glad to do so if we can arrange it as a state-wide meeting sometime next fall. I can't go for a purely local meeting, but I can if it is a state-wide one.

Sincerely,

Kenneth B. Hoyt
Director
Office of Career Education

85

CAREER EDUCATION
Curriculum Coordinators
DYER SCHOOL
52 Alfred Street
South Portland, Maine 04106

March 14, 1975

Mr. Robert Edmondson
Director of Career Education
985 Farmington Avenue
Box 450
Bristol, Connecticut 06010

Dear Bob:

Having been in Career Education since the fall, I realize how much time must have been spent in preparing the materials you were generous enough to share with us. What an impressive list of units your teachers have created and what a range they have covered. Certainly they have developed activities that relate English and Career Education. The evaluation was a valuable feature of the unit.

I am grateful for your kindness and do appreciate your cooperation.

I have enclosed a sampling of our projects which you may find of interest.

Yours truly,

Mary Cruise

Mary Cruise

MC/do

Enclosures

St. Ann School
241 West Street
Bristol, Connecticut 06010

APR 17 1975

April 15, 1975

Mr. Robert J. Edmondson
Director, Career Education Program
Bristol Board of Education
Bristol, Connecticut 06010

Dear Mr. Edmondson:

This letter comes as an expression of gratitude for the services we have enjoyed this year, thanks to your program.

The students were especially enthusiastic about their career-oriented trip to the Wadsworth Atheneum early in April. The video taping was a new experience for them also.

Mr. Lopez' assistance in the woodworking & refinishing classes was a profitable learning experience, too.

I would like at this time to commend Mr. Lopez for his fine work. He is enthusiastic and dedicated — a pleasure to work with.

The four girls who took part

St. Ann School
241 West Street
Bristol, Connecticut 06010

in the Shadow Program found it most enriching because of Mr Lispie' efforts to see this through.

Once again, thank you for letting us benefit of your program.

Sincerely,
Sr Claudette Lauzier, S.N.D.

OF EDUCATION
FARMINGTON AVENUE
P. O. BOX 450
L, CONNECTICUT 06010

BRISTOL PUBLIC SCHOOLS

June 5, 1975

JUN 6 1975

Mr. Robert J. Edmondson, Director
Career Education
Wolcott Street
Bristol, Connecticut

Dear Bob:

The regional in-service activity on Career Education and Counseling sponsored by the local Adult Basic Education came to a close on Monday, June 2. The entire activity consisted of six, three-hour sessions. The general responses to the activity and to the instructor, Dr. Goodwin, were excellent.

The purpose of this letter is to acknowledge the fact that two of your staff members attended these sessions and a third, provided us with a good deal of help and cooperation. The staff members include Kathleen Quinn, Angelo Llopis, and Richard Matt.

Mr. Matt allowed us to use the Career Education Resource Center for our meetings. In addition, he was instrumental in setting up the television equipment used at the workshops. Another very important piece of equipment which he faithfully set up for our meetings was the coffee pot.

Miss Quinn and Mr. Llopis also proved invaluable. They usually are the first to arrive, therefore, were of great help in setting up the room for our use. Kathy took charge of the coffee as well. In fact, they also were the last to leave and further helped in the clean-up and reorganization of the Resource Center.

Needless to say, I was very appreciative of their help and thankful for their attendance.

Sincerely,

Anthony C. Acampora

Anthony C. Acampora
Director of Adult Education

ACA:llb
c.c.: Kathleen Quinn, Angelo Llopis,
Richard Nolan, Richard Matt

89

JUN 3 1975

June 2, 1975

Mr. Frank Dolce, Specialist
Career Education
Mt. View School
71 Vera Road
Bristol, Connecticut 06010

Dear Mr. Dolce:

Thank you for participating in our sharing session on "Woodplay" which was held on May 28, 1975.

Your demonstration of the tool kit and discussion related to it was certainly a valuable part of the session. While the group was small, I felt the sharing of ideas and sharing of important information made this session worthwhile. I am especially glad you mentioned the safety glasses and that these are available through the Career Eduvation Program.

Thank you once again for your cooperation and assistance with this activity.

Sincerely,

Dale H. Wentzel, Supervisor of
Elementary Education

DHW/sdk
cc: Mr. Robert Edmondson

APR 10 1975

Thomaston Public Schools

DOUGLAS C. HARLOW
PRINCIPAL
283-4537

GROVE STREET SCHOOL
THOMASTON, CONN. 06787

April 9, 1975

Mr. Robert J. Edmondson
P. O. Box 450
985 Farmington Avenue
Bristol, Connecticut 06010

Dear Mr. Edmondson;

I have reviewed the copy of the three curriculum guides that you have developed for Career Education. The time and hard work you expended on this endeavor is obvious. I feel it is an extremely well done curriculum. I am circulating it within the school system to selected teachers. I will forward their comments to you. I was particularily impressed with the awareness material at the primary level, and will be curious as to the teachers' thoughts.

Some day soon I would like to visit your facility, and in turn, if I can be of any assistance to you, please let me know.

Sincerely yours,

Edward D. Wilkinson

Edward D. Wilkinson
DIRECTOR, CAREER EDUCATION

EDW:bw

Cc: Dr. Yaffe
Mr. Conaghan
Mr. DeVeber
Mr. Harlow

91

JAN 9 0 1975

January 16, 1975

Dr. Row
Superintendent of Schools
Bristol Public Schools
Bristol, Connecticut

Dear Dr. Row:

Just a note of appreciation for allowing me to observe career education classes in your school system. I was treated so very kindly by principals, teachers and especially by Mr. Edmonson. The career education program impressed me as certainly one which is relevant to the students' needs.

Again, thank you for the opportunity to visit your system.

Sincerely,

Sharon J. Malak

Sharon J. Malak (Ph.D.)
Research Specialist

SJM/kb

cc: Mr. Edmonson

Auerbach Service Bureau For Connecticut Organizations
Supported By
The Beatrice Fox Auerbach Foundation

Chase Going Woodhouse, Director

936 Main St. 11th Floor
Hartford, Connecticut 06115
Phone 249-9711-Ext. 501

March 21, 1975

MAR 25 1975

Dear Mr. Edmondson:

This is just to report that we were glad to receive your material for distribution at our Education Forums.

We do keep in our Resource Center copies for distribution of material oneducation so should you have further p amphlets, we should be very glad to see that they are on display and available to people interested.

Sincerely,

Chase Going Woodhouse
Director

Mr. Robert J. Edmondson
Director, Career Education
985 Farmington Avenue
Bristol, Conn. 06010

CGW/ap

93

St. Ann School
241 West Street
Bristol, Connecticut 06010

March 12, 1975

Gentlemen:

I have found that participation in the various Career Education programs has been most beneficial. For example, in November we had a guided tour of the Bristol Hospital. There the students were exposed to the many jobs available in a hospital.

On another occasion, we had a blind boy and a worker from the Oakhill School for the Blind who came to speak to us. This presentation gave the students some insights into the types of equipment which a blind person would use. The mobile worker also explained her work.

Recently, we were made aware of how important it is to study decimals. The children actually worked with a micrometer and were given a fine presentation on the work of a tool and diemaker.

Thanks to Mr. Frank Dolce, some of the boys who have a difficult time academically were given a chance to use the engraving machine. They made the name plates for the mailboxes which the eighth graders had built under Mr. Angelo Llopis' guidance earlier in the year.

Career Education, in brief, is a wonderful way of making the pupils aware of the many job opportunities which are available. Also, this helps to instill in the students a greater respect for the people who work at different jobs.

Thank you.

Sr. Elizabeth Morin

(Sr. Elizabeth Morin,
Sixth grade teacher)

94

March 5, 1975

Mr Robert J. Edmondson
Director, Career Education
237 Wolcott St
Bristol, Conn

Dear Mr. Edmondson:

I was very happy about doing the demonstration on a styling career. Career Education is a fine thing to acquaint students to our field. Please feel free to call on me at any time in the future. I will be glad to offer you any assistance.

Sincerely yours,

James A. Parsons

James A. Parsons

BRISTOL, CONN. PRESS, Tuesday, March 4, 1975

skilled scissors of barber Jim Parsons.

95

JAN 20 1975

COMMANDER
NAVY RECRUITING AREA ONE
SCOTIA, NEW YORK 12302

IN REPLY REFER TO

15 January 1975

Mr. Robert EDMONDSON
Editor
"The Exchange"
Bristol Career Education Center
237 Wolcott Street
Bristol, CT 06010

Dear Mr. EDMONDSON,

I was very pleased to receive Volume II Number XII of The Exchange.

You certainly have a wide and diversified program. I am especially pleased to see a strong emphasis in the elementary field.

If it were only possible for us to share our work with those in other states! In my travels I see so many excellent programs in so many different schools. We must start an area consortium for idea and media exchange.

Please send me further copies of The Exchange.

If there is any way I may be of service, please call on me.

Sincerely

Delbert A. Hillen

Delbert A. HILLEN
Education Specialist
Navy Recruiting Area ONE

BRISTOL CENTRAL HIGH SCHOOL
480 WOLCOTT STREET
P. O. BOX 700
BRISTOL, CONNECTICUT 06010

BRISTOL PUBLIC SCHOOLS

March 13, 1975

Mr. Robert Edmundson
Director Career Education
Bristol Board of Education
Bristol, Connecticut 06010

Dear Mr. Edmundson:

The staff and students of Bristol Central High School are very happy to be a part of the Bristol Career Education Program. This federally financed program is giving us the opportunity of intergrating career information into the curriculum on a continuing basis. We feel that this approach will do a great deal to make our students aware of the many careers open to them in our society.

We hope that the program may be broadened by securing additional funds in the near future.

Sincerely,

John E. Harrison Jr

John E. Harrison, Jr.
Director of Guidance

JEH:ct

THE FLETCHER-TERRY COMPANY

SPRING LANE • FARMINGTON, CONNECTICUT 06032

March 11, 1975

Mr. Robert Edmondson
237 Wolcott Street
Bristol, CT 06010

Dear Mr. Edmondson:

Recently I had the privilege of speaking to the Typing II class at Bristol Eastern High School. I enjoyed it very much and found the students to be alert and very attentive.

I certainly feel that Bristol's Career Education Program has done much for our community and, hopefully, will continue its operations for many years to come.

Best wishes for your continued success.

Sincerely,

Alice Voisine

Alice Voisine
Executive Secretary

TBV

98

ACCESSION NUMBER: VT102482

PUBLICATION DATE: JUL74

TITLE: THE DETERMINATION OF COMPETENCIES IN THE HOTEL-MOTEL INDUSTRY WITH IMPLICATIONS FOR CURRICULUM DEVELOPMENT FOR POST-SECONDARY DISTRIBUTIVE EDUCATION COOPERATIVE STUDENTS IN PHILADELPHIA, PENNSYLVANIA.

PERSONAL AUTHOR: PATTERSON, JOHN MILLER

DESCRIPTOR: *TASK ANALYSIS; *EMPLOYMENT QUALIFICATIONS; CURRICULUM DEVELOPMENT; COOPERATIVE EDUCATION; DISTRIBUTIVE EDUCATION; JOB SKILLS; *TASK PERFORMANCE; DOCTORAL THESES; POST SECONDARY EDUCATION; *TOURISM; *HOTELS

IDENTIFIER: PHILADELPHIA

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 104P.; ED.D. DISSERTATION, TEMPLE UNIVERSITY.

ABSTRACT: THE PURPOSE OF THIS DISSERTATION WAS TO DETERMINE THE ACTUAL TASKS PERFORMED BY HOTEL OR MOTEL ROOM CLERKS AND CASHIERS. DATA WERE COLLECTED, USING AN INSTRUMENT CALLED THE TASK COLLECTION INTERVIEW GUIDE, FROM OBSERVERS, EMPLOYEES, AND MANAGERS IN NINE PHILADELPHIA HOTELS OR MOTELS FOR EACH JOB CATEGORY, INCLUDING FREQUENCY AND IMPORTANCE OF TASK PERFORMANCE. FIVE HOTEL AND MOTEL EXECUTIVES IDENTIFIED QUALIFICATIONS NECESSARY FOR TASK PERFORMANCE--COMMUNICATIVE SKILLS AND POSITIVE ATTITUDE TOWARD THE PUBLIC FOR BOTH OCCUPATIONS, WITH ABILITIES IN MANAGEMENT OF MACHINES, MONEY, AND NUMBERS AND DECISIONMAKING WITHIN ESTABLISHED POLICY ADDED FOR CASHIERS. IMPLICATIONS AND RECOMMENDATIONS FOR CURRICULUM DEVELOPMENT INCLUDED: USE OF OBSERVATION METHOD FOR DISTRIBUTIVE AND COOPERATIVE EDUCATION, KNOWLEDGE OF TASK FREQUENCY, MORE EMPHASIS ON ROOM CLERK AND CASHIER TRAINING GEARED TO THE POSTSECONDARY LEVEL, EMPHASIS ON COMPUTERIZED RESERVATION SYSTEM, AND A PROGRAM OF CROSS-TRAINING FOR ROOM CLERKS AND CASHIERS. (KJ)

INSTITUTION NAME: TEMPLE UNIV., PHILADELPHIA, PA.

SPONSORING AGENCY NAME: OFFICE OF EDUCATION (DHEW), WASHINGTON, D.C.

102482

THE DETERMINATION OF COMPETENCIES IN THE HOTEL-MOTEL INDUSTRY WITH IMPLICATIONS FOR CURRICULUM DEVELOPMENT FOR POST-SECONDARY DISTRIBUTIVE EDUCATION COOPERATIVE STUDENTS IN PHILADELPHIA, PENNSYLVANIA

Submitted to the
Temple University Graduate Board

In Partial Fulfillment
of the Requirements for the Degree
of Doctor of Education

by
John Miller Patterson

July, 1974

VT 102 482

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INTRODUCTION

A question, significant to the purposes of post-secondary education might be: "Are we actually going to prepare people to live in the society in which we are existing at the present time?" Wattenbarger (1969), in asking this question, emphasizes that society in the 1960's and 1970's has become even more complicated than that of the 1940's and the 1950's.

Sweeping changes caused by technology are apparent. New methods, materials, and systems are shaping a new society in which knowledge and skills are very important.

Therefore, each year there are fewer low-skill jobs and more openings for highly trained personnel in industry, business, technical fields, and the many services that minister to human needs (Congress, 1968).

Partly because of the impetus of the Vocational Education Act of 1963 and Amendments of 1968, vocational educators have placed more importance on curriculum development in post-secondary education.

Recently, several studies have been completed which have implications for curriculum development for post-secondary programs in the hotel-motel occupations.

The hotel-motel industry is vast and expanding. During the past two decades, the requirement for trained personnel to work in hotels, motels, food service

operations and institutions has been increasing and the need for more educational programs in the field has been recognized (Almarode, 1967).

According to a report of the American Hotel and Motel Association, growth figures showing the percentage of increase of employees for four industries: agriculture, manufacturing, hotel-motel, and transportation; the hotel-motel industry will have the largest growth rate in jobs over a 10 year period from 1965 through 1975. By 1980, it is expected that one million people will be employed and gross sales will be in the 12 billion dollar range. The latest figures compiled for the hotel-motel industry by the U.S. Department of Commerce place the gross sales at 7.1 billion dollars.

The growth of the hotel-motel industry points out the importance of providing a task analysis and competency determination to provide for curriculum development in distributive education.

An important concept in curriculum development is that task analysis based on observation of the worker is the most appropriate method for determining tasks (Mager, 1967).

This study analyzed two occupations considered by the hotel-motel industry to be in the middle management classification. The tasks were determined by observing the selected job categories of room clerk and cashier under actual job conditions. The rationale that individuals tend to say what other people want to hear supported the utilization of the observation technique for task determination.

CHAPTER I

THE PROBLEM

It is not uncommon for curricula decisions to be made on the basis of invalid data. All too frequently, students are required to develop competencies which have no value in the "real world." Similarly, they do not have the opportunity to develop many competencies which do have "real world" value.

It is a basic principle of vocational education that curriculum decisions be reached after occupations are analyzed further, that analysis be performed by an individual who actually observes workers performing the task associated with an occupation.

Unfortunately, the aforementioned or foregoing principle is often violated. At times, an analysis is not performed. At other times, the analysis is performed without the observation techniques being included.

Recently, Crawford (1967) completed a study to identify competencies within several occupational areas. Two job titles included in her competency study were: (1) hotel or motel room clerk and (2) hotel or motel cashier. Without a doubt, a number of vocational investigators have, or will, make curricular decisions based on this study. Since Crawford's study involved structured interviews, this paper will show the results based upon actual observation of the employee performing the tasks, thus utilizing both research methods.

A. Statement of the Problem

The primary purpose of this study was to determine the actual tasks performed by (1) hotel or motel room clerks and (2) hotel or motel cashiers. Further, to determine how often these tasks were performed and how important the observer, employee and supervisor perceived each task in the job titles previously mentioned.

Since Crawford (1967) collected competency (task) data from employees and employee's supervisors via questioning, another purpose of the study was to show results based upon actual observation of the employee performing the task utilizing both research methods of data collection when collecting task data for (1) hotel or motel room clerks and (2) hotel or motel cashiers.

Finally, a purpose of this study was to answer the following questions:

1. Should tasks associated with (1) room clerk and (2) cashier be developed in a secondary or post-secondary vocational education program?
2. Which tasks associated with room clerk are also associated with cashier?
3. Does the fact that the hotel or motel is a luxury or non-luxury operation influence the tasks performed by a room clerk and cashier?

B. Significance of the Study

According to an industry spokesman, David Arnold, Philadelphia has a shortage of hotels which fall into the category of new first-rate hotels that offer

a full range of services. Arnold (1973), speaking for a leading firm of management consultants for the hotel-motel industry, indicated that activities and plans for future hotel construction is above average. This same firm found that 80 percent of the city's first-rate rooms are in hotels 30 to 50 years old.

A spokesman for the Philadelphia Industrial Development Corporation said in a recent newspaper article that at least a dozen hotels are in various stages of planning to be completed by 1976. Industry and community spokesmen give indications that the city is experiencing a hotel boom (Egan, 1973).

Harms (1970) found that the need for hotel front office clerks in the Philadelphia Labor Market Area would increase from 1,614 in 1970 to 2,552 in 1980.

Existing programs in hotel-motel and hospitality management were found in the Community College of Philadelphia and Bucks County Community College.

Crawford (1967) in "A Competency Pattern Approach to Curriculum Construction in Distributive Teacher Education," recommended that further research be conducted to validate the competencies she identified. She recommended that the research be undertaken in other geographic areas.

This study was significant in that it related to curriculum development for hotel-motel programs in distributive education in an other metropolitan area.

C. Definition of Terms

The terms used in this study consist of the following meanings:

1. Task refers to a logically related set of actions required before an individual can demonstrate competence in job performance.

2. Competency refers to the ability of an individual to perform a specific task proficiently.

3. Vocational Cooperative Education is a work experience program designed to develop knowledges, abilities, and skills for individuals preparing for the world of work at a job station and correlated classroom instruction (Mason and Haines, 1972).

4. Distributive Education is a vocational instructional program designed to meet the needs of persons who entered, or are preparing to enter, a distributive occupation or an occupation requiring competency in one or more of the marketing functions (Crawford and Meyer, 1972). This study refers only to those marketing functions in the hotel-motel occupations.

5. Hotel-Motel Industry is that segment of the industry providing away-from-home meals and lodging for the traveling public (Almarode, 1967).

6. Post-Secondary Education refers to those programs designed to meet the needs of persons who have completed or left high school and are enrolled as full-time students in a community college, junior college or an area vocational-technical school (Crawford and Meyer, 1972).

7. Cashier refers to that person in the hotel front office responsible for recording transactions of guest accounts, making financial

settlement with guests at check-out time, and acts as liaison with other departments.

8. Room Clerk, who is also referred to as a front office salesman, is that individual to whom responsibility for actual registration and assignment of room to a guest has been delegated.

9. Vocational Education is that phase of education dealing with preparing individuals for employment, including training for job entry, retraining and upgrading training for job advancement (Crawford and Meyer, 1972).

10. Middle Management refers to those jobs requiring training in that segment of the organization which includes personnel with limited delegated authority and implies a superordinate and subordinate.

11. Luxury Hotel-Motel refers to a hotel or motel that by the nature of the service offered appeals to a customer from a higher social economic group.

12. Commercial Hotel-Motel refers to a hotel or motel that appeals to a customer generally more concerned with rates rather than the service offered.

13. Validity is an evaluation of the relationship between measures or different variables.

D. Delimitations

This study was delimited to the hotel-motel industry in Philadelphia and those properties located on the fringe areas which are considered significant to the economy of the city.

This study was further delimited to those competencies within the marketing area deemed necessary for persons holding middle management jobs in the hotel-motel industry.

E. Limitations

This study was concerned with tasks performed in the job categories of room clerk and cashier. The data collected was limited to the psychomotor domain. The population consisting of nine hotels or motels was randomly selected from a list of 22 hotels and motels comprising the Philadelphia Membership of the American Hotel and Motel Association. Data was collected from 27 respondents composed of observers, employees and supervisors in nine hotels.

CHAPTER II

REVIEW OF THE LITERATURE

The literature contains many studies emphasizing the importance of determining tasks when ascertaining competencies needed to perform the task. In a search of the current literature, no studies were found dealing with determination of tasks in the hotel-motel occupations with implication for curriculum development in post-secondary education. The literature is grouped under two areas: (1) studies concerning task analysis and (2) studies concerning curriculum development.

A. Task Analysis

Larson's (1969) "Review and Synthesis of Research Analysis for Curriculum Development in Vocational Education" refers to a number of studies concerning task analysis. Although no studies for task analysis relating to occupations in the hotel-motel industry were found, several have been included in this review of the literature because of their importance to the study.

Chenzoff and Folley (1965), in their work entitled "Guidelines for Training Situation Analysis," characterize task analysis as a method or process by which a task is examined and its characteristics, in terms of certain attributes, are identified.

The Aerospace Medical Research Laboratories in a recent publication describes the development and evaluation of a Learner-Centered Instruction program based on task analysis (Valverde, 1968). This report emphasizes that task analysis is a technique of analysis which can be a significant tool in predicting job behavior that can be converted to relevant training objectives.

In a report, Carr and Silverman (1966) describe the three major steps of the Systematic Approach to Multidimensional Occupational Analysis (SAMOA) developed and used by the Navy. The steps included the development and administration of comprehensive task lists and related data-gathering forms, the computerized analysis of the data on tasks and task patterns, and a set of computerized procedures for stratifying and grouping clusters on the basis of significant variables within three fundamental dimensions of the work situation.

Smith (1965), in a study, compared the differences as well as the common elements of various approaches to task analysis.

Silverman (1967), in another report, recommended that a task taxonomy be developed which would indicate the inherent similarities between tasks, independent of their environment, and pave the way for improvements in training.

Drake (1968) employed the concept of task analysis in a study of the occupational training needs of persons entering employment in off-farm agricultural occupations in New York State.

The functional applications of task analysis are outlined in a Florida State Department of Education bulletin "Guidelines for the Training of Nurses' Aides

(1968)." Emphasis is placed on organizing the tasks into a purposeful sequence or pattern in accordance with sound educational concepts to develop the course of study.

Mager and Beach (1967), in a publication entitled "Developing Vocational Instruction," reported that task analysis based on observation of the worker on the job is the most reliable method of determining tasks.

According to Butler (1967), a task description is usually developed in three stages: first, the duties of each job are outlined; second, the tasks for each of the duties are listed; and third, the task analysis identifies standards of performance.

In his book "The Conditions of Learning," Gagne (1965) identified five categories of performance that describe actions of individuals when the task is performed properly.

Butler (1972) found that the validity of course design decisions is directly related to care and accuracy with which the task analysis is done. With the task analysis completed, the next step, according to Butler, in the system design process is to develop the training objectives from the information developed by the task analysis.

B. Curriculum Development

In her study, Crawford (1967) recommended further research to determine the distributive education curriculum needed at post-secondary level to develop the technical competencies identified. She further recommended that a need exists to construct and classify educational objectives with implications for

curriculum construction.

Trent (1973) suggested, as an industry spokesman, that there should be a minimum emphasis on technical preparation in class and more attention to the cooperative training aspect of the hotel-motel programs. He emphasized that on-the-job training was especially appropriate for the middle management area. He also felt that workers in this field need more preparation in communicative and decision-making competency areas.

According to Trent, experts in the industry feel that the greatest need for training lies with the second line supervision on middle management area.

According to White (1973), hotel management views the job categories, room clerk and cashier, as middle management because of the decision-making process which is often part of the job performance.

Harris (1971) found that an analysis of data indicated that employers in wholesale and service businesses indicated that individuals who are employed as full-time workers need more understanding and preparation in the written communications competencies area than did employers in the field of retailing. He found in the data concerned with competencies of distributive education graduates that individuals who are to be employed as full-time workers in service classified businesses need a more extensive understanding and preparation in the decision-making competencies area.

Shiply (1967), in a study, identified the tasks performed by employees in three home related occupations one of which was hotel-motel housekeeping aides.

She recommended that common and unique knowledges and competencies be determined in order to suggest training programs.

Crawford (1967) in Volume IV of her study "A Competency Pattern Approach to Curriculum Construction in Distributive Teacher Education" determined the critical tasks required of distributive workers in 17 selected jobs in hotel and motel occupations and the competencies needed to perform the tasks.

The Crawford study was concerned with workers in three cities in Virginia, and tasks were identified by structured interview. The study served as the basis for developing the task collection interview guides and the forerunner of this study.

The observation technique and task analysis not performed in the Crawford study was undertaken in this study to identify task peculiar to the job categories of room clerk and cashier in selected hotels and motels in Philadelphia. The original task list was changed as a result of observation and tasks were added and re-written when appropriate.

Ertel (1968) found, in a study undertaken to obtain data needed to design distributive education curricula for non-college bound youth, that these youth are relatively restrained to non-supervisory categories of jobs until they pursue some additional educational goals or have extensive experience. He suggested some post-high school education is desired for employment in the supervisory level of jobs. Ertel illustrates his point by stating: "these facts suggest a preparatory distributive education curricula with instructional program designed around a set

of behavioral objectives reflecting those activities performed by substantial percentage of non-supervisory respondents in this study."

Ertel (1968) found that some post-high school education is important in securing positions at the supervisory level and suggested that vocational education for performance of activities related to performances of supervisory activities should be in a post-high school program or as near the termination of the educational preparation for the job as is feasible. He maintained that some elements of the subject matter, educational goals, and behavioral outcomes of today's high school cooperative programs should be re-scheduled as a post-high school program. He reported that an analysis of the activities performed by the supervisors show high priority to judgement and decision-making skills, to interpersonal relations, and to activities which are coordination functions. He felt this content was more appropriate for post-high school distributive education curriculum.

Berry (1963) developed a model for vocational curriculum research along with the study of "The Role of Office Practice Instruction in the Training for General Office Assignments." She developed job descriptions for 19 major office jobs from information provided by employers and personnel managers, and tested the validity of these descriptions by interviews with employees. As a result of inconsistencies found between accepted descriptions of the role of general office employees and what they actually do in performance of their task, she recommended extensive revision for the office occupations curriculum.

In a study of competencies and knowledge needed by teachers of distributive

education subjects, Haines (1965) analyzed textbooks, course syllabi, and instructional materials to determine content commonly taught in distributive education classes, but no attempt was made to ascertain the specific tasks critical to the performance of occupations.

A report of the American Institute for Research outlines seven steps required to formulate course objectives. Objectives are derived from statements of performance constituting work done in specific jobs or job clusters. These objectives are translated into curricula by deriving from patterns of performance types and levels of knowledge and capabilities assumed to be essential for effective task performance.

Ashmun and Larson's (1968) "Review and Synthesis of Research in Distributive Education" includes 148 studies, publications, bulletins, and other scholarly works and covered the years 1966 through 1968. There are no references in the review to studies for task analysis relating to occupations in the hotel-motel industry with implication for curriculum development in post-secondary education.

Almarode (1968) in his "Follow-up Study of Junior College Hotel and Restaurant Education in Florida," which compares the curriculum of six junior colleges in three areas of education: (1) general, (2) business and electric, and (3) technical hotel and restaurant, found that the colleges allow as much as 18 credit hours for on-the-job experience. He also found that most graduates appear to be successfully employed in the industry or continuing in their education.

Crawford (1972) found that the Panel of Consultants, appointed by President

Kennedy in 1961, made an extensive study of the need for vocational-technical training beyond the high school level. They cited the needs of business and industry for more mature workers with greater knowledge and skills than the graduate of high school vocational programs. They noted the advantage that the post-secondary institution has in being able to offer programs of instruction that are more concentrated in time and content than similar programs offered in the high school.

Mason and Haines (1972) found that the nature of the skills, concepts, and attitudes required in each occupation affects the way the cooperative instruction occurs, which is the pattern of competencies to be acquired.

Harrison (1973) is supervising a study in progress of the development of competencies into learning activities packets to be used for individual small or large group instruction.

In a search of the literature, no study was found that concerned itself with determination of task in the hotel-motel middle management occupations with implications for curriculum development in post-secondary education.

None of the studies reviewed utilized the observation technique for task determination.

Mager (1967) found that an important concept in curriculum development is that task analysis based on observation of the worker is the most appropriate method for determining task.

Training for cooperative distributive education students who plan to enter hotel-motel occupations at the middle management level was recommended in the literature review only when accomplished at the post-secondary level. However,

comments from White and Trent (1973) revealed their opinion that cooperative training is suitable at the secondary level when the trainee possesses a mature attitude and is a legal age for employment.

CHAPTER III

METHODS AND TECHNIQUES

I. INTRODUCTION

The purpose of this chapter is to explain the procedure employed in collecting the data and to describe the selection of the sample.

An important concept in curriculum development is that the most appropriate method for determining tasks is observation of the worker.

A purpose of this study was to determine tasks performed by hotel or motel room clerks and hotel or motel cashiers. How often these tasks were performed and how important the observer, employee and supervisor perceived each task was also determined.

Another purpose of the study was to show results based upon observation of the employee performing the tasks and the method of interviewing used by Crawford (1967), thus utilizing both research methods of task collection when determining tasks performed by hotel or motel room clerks and hotel or motel cashiers.

The study also sought to determine answers to the following questions:

1. Does the fact that the hotel or motel is a luxury or non-luxury operation influence the tasks performed by room clerks and cashiers?
2. Which tasks associated with room clerks are also associated

with cashiers?

3. Should tasks associated with room clerks and cashiers be developed in a secondary or post-secondary vocational education program?

A. Preparing the Instrument for Data Collection

The first step in preparing for data collection was to list all the tasks necessary for an individual to perform the following occupations in the middle management categories: room clerk and cashier. The tasks were taken from three primary sources:

1. Tasks, as listed in Volume IV of the study "A Competency Pattern Approach to Curriculum Construction in Distributive Teacher Education" (Crawford, 1967).
2. Interviews with supervisors of person being observed.
3. Interviews with individuals performing the selected occupations in hotels.

After the list of tasks was completed an instrument called a task collection interview guide was prepared and individuals being interviewed were asked to indicate, by placing the numbers 1 to 4 in the right hand colume of the interview guide, indicating which of the tasks listed were performed (1) regularly, (2) occasionally, (3) never, and (4) were not able to respond. They were also asked to rate the importance of the task on a scale of 1 to 4, as follows: (1) great, (2) some, (3) little, or (4) no importance. See Appendices A and B, pages 86 and 89. Data was collected from 27 respondents composed of an observer, employee and

supervisor in nine hotels.

The second step in preparing for collecting the data was to construct a task listing sheet (see Appendix C, page 92) on which was recorded:

1. Task number.
2. Task description.
3. Frequency of performance indicated by observer, employee and supervisor.
4. Importance indicated by observer, employee and supervisor.

The third step in preparing for collecting the data was to construct a task detailing sheet (see Appendix D, page 93) on which was recorded:

1. Task number.
2. Steps in performing the task.
3. Categories of performance.

A fourth step in preparing for data collection was the preparation of the top management interview guide. This group was composed of at least one representative of top management from each hotel or motel in the sample.

This group was asked to respond to the following questions:

1. What do you believe will be the turnover rate in this occupational area through 1980?
    a. Do you feel that there will be an increased need in this occupational area? Please indicate your reaction to the need for additional personnel in this occupational area

between 1973 and 1980 by selecting one of the six choices below.

(1) Greatly increased need.

(2) Slightly increased need.

(3) No increased need.

(4) Slightly decreased need.

(5) No decreased need.

(x) Was not able to respond.

b. What influence will the Bi-centennial generate as far as new jobs in this occupational area is concerned?

2. What is your responsibility for selection of incoming personnel?

3. From your experiences, which type of individual would you be most likely to employ?

   a. Qualified high school graduate.

   b. Qualified post-secondary program graduate.

   c. High school graduate.

4. Would a coop-training program in these two occupational areas be appropriate in high school?

   a. Recommended.

   b. Recommended with conditions.

   c. Not recommended.

B. Pilot Study

The pilot study was conducted by interview with individuals performing the same jobs in selected hotels and motels in the same area as those in the sample. Employees and supervisors were asked to complete the task collection sheets and to list additional tasks, if appropriate, and to rate the tasks as to frequency of performance and importance on the same basis as those included in the sample. The interview forms for collecting and rating tasks are included in the Appendices A and B, pages 86 and 89.

C. Data Collection

The data involving tasks was collected while observing individuals performing the tasks called for in the occupational titles room clerk and cashier, and recorded on the task listing and task detailing sheets. See Appendices A and B, pages 86 and 89.

The basis for recordation rather than an exact frequency count was that of categories. Regularly (1) denoted that the task was performed five or more times during an observation, occasionally (2) denoted that a task was performed less than five times during an observation period, (3) and (4) denoted that a task was not performed or respondent was not able to answer respectively.

The observations were performed in nine hotels and motels within the Philadelphia area. The properties selected randomly included the following types:

1. Commercial hotels, including motor hotels operated by a national chain.

2. Luxury hotels.

After the arrangements for the time and place for observation had been completed (see Appendix G, page 96) the observer, using the task collection interview guide for the job category, observed and recorded the category of performance and importance on a scale of 1 to 4. When it was found that one individual was in the dual role of cashier and room clerk, that person was observed in each job situation.

When the observer found that certain tasks listed required a more specific description, he detailed these into steps. These steps of the task were recorded on a task detailing sheet in sequence. The categories of performance were included since they may be of critical importance in deciding which teaching technique is appropriate at each step.

Gagne and Mager (1965) described five categories of performance, which are: (1) discrimination, (2) problem solving, (3) recall, (4) manipulation, and (5) speech. When the task detailing of a specific task was completed one of the five categories of performance was recorded beside it in the appropriate column. See Appendix D, page 93.

The observer, employee and supervisor completed a set of task collection interview guides for each job category, adding tasks performed as part of the job, but not included in the list of tasks.

The task collection interview guides were collected from employees and supervisors, and the ratings of frequency of performance were recorded on the

task listing sheet. See Appendix C, page 92. The time frame for observation was consistently during the hours of 9 A.M. to 6:30 P.M., Monday through Thursday, and approximately one day's duration for each observation.

Information concerning the employment opportunities to determine the potential labor market and innovations requiring training in the industry was also requested from the following sources:

1. The Labor Market Data Bank, School of Business, Temple University.
2. Philadelphia Hotel and Motel Association, a division of the American Hotel and Motel Association.
3. The Bureau of Employment Security.
4. Chamber of Commerce of Greater Philadelphia.

Information concerning employment needs in the industry was also requested of managers in hotels and motels represented in the study.

D. Population

The population consisted of nine hotels or motels which were randomly selected from a list of 22 hotels and motels comprising the Philadelphia membership of the American Hotel and Motel Association. An observer, employee and supervisor from nine hotels or motels comprised a total of 27 respondents.

E. Determination of Competencies

Competencies necessary for performance of tasks were identified by interviewing five executives in hotels or motels in Philadelphia.

The researcher had personal interviews with five hotel executives who

qualified as experts in hotel front office procedures. They are as follows: The resident manager of the Warwick Hotel, the resident manager of the Philadelphia Sheraton, the manager of the Holiday Inn-Midtown, the front office manager of the Benjamin Franklin Hotel, and the front office manager of the Bellevue Stratford Hotel.

Comments were received from each individual interviewed relative to the following questions:

1. What competencies (skills, knowledges, and attitudes) are important at job entry-level for room clerks and cashiers?
2. What future trends are foreseen in the hotel-motel industry that should affect training and employment for the next five years?
3. How will these trends affect the hotel-motel industry within the next five years?

F. Data Analysis

The data was analyzed according to the frequency and importance of task performance for both the room clerk and cashier tasks. Those tasks which were performed regularly and those which were of great importance according to all three respondents (observer, employee and supervisor) were listed in order of the number of hotels providing this information. Tasks specifically performed by luxury and non-luxury hotels were also denoted. Since all tasks were not performed regularly, Kendall's coefficient of concordance was used to measure the agreement among the observer, employee and supervisor respondents on the frequency and

importance of tasks performance for room clerk and cashier tasks.

Since the population was small and assumptions for parametric statistics could not be met, Kendall's rank correlation coefficient was used to measure agreement between luxury and non-luxury hotels on frequency of tasks performance of room clerk and cashier tasks.

Tabulation of the frequency and importance of task performance by hotels was performed using the Statistical Package for Social Science. Kendall's coefficient of concordance and Kendall's rank correlation coefficient were computed using NPAR which is a non-parametric statistical package. The programs were run on the CDC 6400 computer at Temple University.

CHAPTER IV

FINDINGS

The purpose of this chapter is to present the findings which are based on an analysis of the data generated by research conducted during the course of the study.

The data described in this chapter is a result of research based on observation of the individual performing the task.

When developing curriculum for the hotel and motel industry, it is important to know which tasks occurred most frequently.

Table 1 presents all 40 room clerk tasks and shows the number of hotels responding that reported the tasks as being performed regularly.

Note: each hotel had three respondents. When a task was listed as being performed regularly, all three respondents for that hotel agreed that the task was done regularly.

Of the 40 room clerk tasks rated, Tasks

No. 13. Time stamps registration card

No. 33. Promotes the hotel and motel by giving immediate and courteous service to guests

were reported as being performed regularly by all hotels, both luxury and non-luxury.

TABLE 1

FREQUENCY OF TASK PERFORMED REGULARLY BY ROOM CLERKS ACCORDING TO NUMBER OF HOTELS RESPONDING

Task	Number of Hotels (N=9)	Number of Luxury (N=3)	Number of Non-Luxury (N=6)
1. Rents and assigns rooms to guest	8	2	6
2. Greets guests and asks what type of room is desired	6	2	4
3. Quotes prices of rooms trying to rent more expensive ones first	3	1	2
4. Assists guests in registering for rooms	7	3	4
5. Writes room number on registration card	8	2	6
6. Summons bellman and gives him room key	4	2	2
7. Gives bellman any special instructions	1	0	1
8. Maintains room availability count	3	2	1
9. Reserves rooms for guests by consulting reservation file	2	0	2

TABLE 1 (Continued)

Task	Number of Hotels (N=9)	Number of Luxury (N=3)	Number of Non-Luxury (N=6)
10. Arranges transfer of registered guest to other rooms, making out a transfer slip in duplicate	0	0	0
11. Checks out guests	3	1	2
12. Receives room key from guest	1	1	0
13. Time stamps registration card	9	3	6
14. Makes out forms for advanced payment	2	1	1
15. Maintains records of guests' charges, etc.	1	1	0
16. Sorts mail	2	2	0
17. Informs guest of services available	3	2	1
18. Makes advanced reservations	3	1	2
19. Mails reservations acknowledgement to future guests	0	0	0
20. Shows and sells room accommodations	0	0	0

TABLE 1 (Continued)

Task	Number of Hotels (N=9)	Number of Luxury (N=3)	Number of Non-Luxury (N=6)
21. Transmits and receives messages by phone, teletypewriter	4	2	2
22. Arranges registration desk so that it is neat	6	3	3
23. Wears uniform in accordance with the policies of the hotel or motel	3	1	2
24. Displays candy and cigarettes in a convenient place	0	0	0
25. Directs customer's attention to displays of maps and places of interest	0	0	0
26. Displays posters of special events in the community for tourist to see	0	0	0
27. Calls guests' attention to directional signs	1	1	0
28. Supplies guest information on advertised services and facilities	2	1	1
29. Informs hotel and motel personnel involved about advertised services and facilities	0	0	0

TABLE 1 (Continued)

Task	Number of Hotels (N=9)	Number of Luxury (N=3)	Number of Non-Luxury (N=6)
30. Reads own and competitors newspapers or trade journals	0	0	0
31. Points out advertised services or facilities to guest	1	0	1
32. Keeps informed of competition prices and promotional campaigns	0	0	0
33. Promotes the hotel or motel by giving immediate and courteous service to guests	9	3	6
34. Offers guests free copies of community events brochures or entertainment brochures	3	2	1
35. Gives directions to guest	3	2	1
36. Adjusts guests' complaints about rooms or services	2	1	1
37. Authorizes guests bank checks	0	0	0
38. Makes suggestions to guests for entertainment and sightseeing	2	2	0
39. Suggests good restaurants to guests	2	2	0
40. Takes reservations by phone, mail and telegraph	4	2	2

No. 1. Rents and assigns rooms to guest

No. 5. Writes room number on registration card

were found to be performed regularly in eight of the nine hotels.

One task, Task No. 4, Assists guests in registering for rooms, was found to be performed by room clerks in seven hotels or motels.

No. 2. Greets guests and asks what type of room is desired

No. 22. Arranges registration desk so that it is neat

were reported as being performed by room clerks on a regular basis by six hotels.

When examining Tasks No. 6, 21 and 40 respectively, it was found that they were performed by room clerks regularly in four hotels, as seen in Table 1. The tasks are:

No. 6. Summons bellman and gives him room key

No. 21. Transmits and receives messages by phone and teletypewriter

No. 40. Takes reservations by phone, mail and telegraph

Looking at the next group of tasks performed regularly, it was found that the following Tasks: No. 3, 8, 11, 17, 18, 23, 34 and 35 were rated by three hotels while Tasks No. 9, 14, 16, 28, 36, 38 and 39 were rated only by two hotels; and Tasks No. 7, 12, 15, 27 and 31 were rated only by one hotel as being performed regularly (see Table 1, page 28).

Further analysis of Table 1 revealed that Tasks No. 10, 19, 20, 24, 25, 26, 29, 30, 32 and 37 were not being performed regularly.

Table 2 summarizes the 10 most frequently performed tasks by room clerks as rated by observers, employees and supervisors responding.

Table 3 summarizes the tasks most frequently performed by room clerks in specific types of hotels or motels.

Task performance will now be discussed with respect to luxury and non-luxury hotel classification (see Appendix I, page 98).

Task No. 4, Assists guests in registering for rooms, and Task No. 22, Arranges registration desk so that it is neat, were found to be performed by room clerks regularly in all three luxury hotels.

The findings revealed that Task No. 1, Rents and assigns rooms to guest, and Task No. 5, Writes room number on registration card were performed regularly by room clerks in all non-luxury hotels or motels.

The next group of tables were concerned with the frequency of cashier task performance.

Table 4 presents all 32 cashier tasks and rates the frequency of tasks performed regularly according to hotels reporting.

When a task was listed as being performed regularly, all three respondents for that hotel agreed that the task was done regularly.

Of the 32 cashier tasks rated, there was no complete agreement by all nine hotels and motels reporting that certain tasks were performed regularly by cashiers in all hotels and motels.

Three tasks occurred on a regular basis more frequently in eight hotels than

TABLE 2

A CONSENSUS OF RESPONDENTS OF THE MOST FREQUENTLY PERFORMED TASKS BY ROOM CLERKS

Task Range	Task	Number of Hotels (N=9)
1	13. Time stamps registration card	9
2	33. Promotes the hotel or motel by giving immediate and courteous service to guests	9
3	1. Rents and assigns rooms to guest	8
4	5. Writes room number on registration card	8
5	4. Assists guests in registering for rooms	7
6	2. Greets guests and asks what type of room is desired	6
7	22. Arranges registration desk so that it is neat	6
8	6. Summons bellman and gives him room key	4
9	21. Transmits and receives messages by telephone and teletypewriter	4
10	40. Takes reservations by phone, mail and telegraph	4

TABLE 3

TASKS MOST FREQUENTLY PERFORMED BY ROOM CLERKS AS REPORTED BY SPECIFIC HOTEL TYPES

Task	Type of Hotel (Luxury N=3) (Non-Luxury N=6)
13. Time stamps registration card	All hotels
33. Promotes the hotel or motel by giving immediate and courteous service to guests	All hotels
4. Assists guests in registering for rooms	All luxury hotels
13. Time stamps registration card	All luxury hotels
22. Arranges registration desk so that it is neat	All luxury hotels
33. Promotes the hotel or motel by giving immediate and courteous service to guests	All luxury hotels
1. Rents and assigns rooms to guest	All non-luxury hotels
5. Writes room number on registration card	All non-luxury hotels
13. Time stamps registration card	All non-luxury hotels
33. Promotes the hotel or motel by giving immediate and courteous service to guests	All non-luxury hotels

TABLE 4

FREQUENCY OF TASKS PERFORMED REGULARLY BY CASHIERS ACCORDING TO HOTELS RESPONDING

Task	Number of Hotels (N=9)	Luxury Hotels (N=3)	Non-Luxury Hotels (N=6)
1. Receives, sorts and posts charge slips in ledger	8	2	6
2. Files charge slips	5	1	4
3. Receives payment from guests	8	2	6
4. Makes out receipted bills for guests	7	2	5
5. Makes authorized disbursements for C.O.D. and similar items	0	0	0
6. Cashes authorized checks for guests	3	2	1
7. Cashes travelers checks, money orders and makes change	5	2	3
8. Makes daily reports to comptroller, showing amounts of cash received, disbursed and on-hand	6	3	3
9. Receives and stores guests' valuables in safe or safe deposit boxes	1	1	0

TABLE 4 (Continued)

Task	Number of Hotels (N=9)	Luxury Hotels (N=3)	Non-Luxury Hotels (N=6)
10. Makes out bills when guests check out	5	3	2
11. Relieves switchboard operator	1	1	0
12. Assists the room clerk during rush periods	3	2	1
13. Turns cash over to the audit department	6	3	3
14. Maintains the amount of cash needed in the cash drawer	8	3	5
15. Informs dining room or switchboard operator of guests who have paid in advance for follow-up on meal and telephone call charges	1	0	1
16. Gives directions to guests	2	2	0
17. Adjusts guests' complaints about rooms or services	0	0	0
18. Authorizes guests' bank checks	0	0	0
19. Makes suggestions to guests for entertainment and sightseeing	0	0	0
20. Suggests good restaurant to guest	0	0	0
21. Takes reservations by phone, mail and telegraph	1	1	0

TABLE 4 (Continued)

Task	Number of Hotels (N=9)	Luxury Hotels (N=3)	Non-Luxury Hotels (N=6)
22. Arranges registration desk so that it is neat--never cluttered	2	2	0
23. Directs guests' attention to displays of maps and places of interest	0	0	0
24. Supplies guest information on advertised services and facilities	1	1	0
25. Records charges for local and long distance calls when guests check out	4	1	3
26. Makes note of guest making unusual charges	2	0	2
27. Receives and makes voucher for city ledger accounts	3	1	2
28. Verifies name of guest from ledger with any charge having that guest's name	3	1	2
29. Notifies registration if guest decides to extend stay	3	1	2
30. Receives key from guest	2	1	1
31. Receives report from night audit	0	0	0
32. Posts all charges to guest's account	4	1	3

all other tasks rated. They are as follows:

No. 1. Receives, sorts and posts charge slips in ledger

No. 3. Receives payment from guests

No. 14. Maintains the amount of cash needed in the cash drawer

Second in order of tasks noted according to frequency was Task No. 4, Makes out receipted bills for guests, which was performed regularly by cashiers in seven hotels.

Analysis of Tasks No. 8 and No. 13 showed that six hotels agreed that these cashier tasks should be performed on a regular basis. They are:

No. 8. Makes daily reports to comptroller showing amounts of cash received, disbursed and on-hand

No. 13. Turns cash over to the audit department

Three tasks were reported by five hotels to have a frequency of performance regularly by cashiers. They are:

No. 2. Files charge slips

No. 7. Cashes travelers checks, money orders and makes change

No. 10. Makes out bills when guests check out

A review of the remaining tasks revealed that Tasks No. 25 and No. 32 were reported by four hotels to be performed by cashiers regularly. Further, Tasks No. 6, 12, 27, 28 and 29 were reported by three hotels, and Tasks No. 16, 22, 26 and 30 were performed regularly by cashiers in two hotels. Tasks No. 9, 11, 15, 21 and 24 were reported by one hotel as being performed regularly.

Among the findings, certain tasks were rated by all hotels as not being regularly performed by cashiers. They are:

No. 5. Makes authorized disbursements for C.O.D. and similar items

No. 17. Adjusts guests' complaints about rooms or services

No. 18. Authorizes guests' bank checks

No. 19. Makes suggestions to guests for entertainment and sight-seeing

No. 20. Suggests good restaurant to guest

No. 23. Directs guests' attention to displays of maps and places of interest

No. 31. Receives report from night audit

Table 5 summarizes the 11 most frequently performed tasks by cashiers as rated by observers, employees and supervisors responding.

Cashier tasks performance will now be discussed with regard to luxury and non-luxury hotel classification (see Appendix I and Table 6, pages 98 and 42).

Table 6 shows the tasks most frequently performed by cashiers in specific types of hotels and motels.

Four tasks were performed by cashiers regularly in all luxury hotels. They are:

No. 8. Makes daily reports to comptroller, showing amounts of cash received, disbursed and on-hand

TABLE 5

A CONSENSUS OF RESPONDENTS OF THE MOST FREQUENTLY PERFORMED TASKS BY CASHIERS

Task Rank	Task	Number of Hotels (N=9)
1	1. Receives, sorts and posts charge slips in ledger	8
2	3. Receives payment from guests	8
3	14. Maintains the amount of cash needed in the cash drawer	8
4	4. Makes out receipted bills for guests	7
5	8. Makes daily reports to comptroller, showing amounts of cash received, disbursed and on-hand	6
6	13. Turns cash over to the audit department	6
7	2. Files charge slips	5
8	7. Cashes travelers checks, money orders and makes change	5
9	10. Makes out bills when guests check out	5
10	25. Records charges for local and long distance calls when guests check out	4
11	32. Posts all charges to guest's account	4

TABLE 6

TASKS MOST FREQUENTLY PERFORMED BY CASHIERS REPORTED BY SPECIFIC HOTEL TYPES

Task	Type of Hotel (Luxury N=3) (Non-Luxury N=6)
8. Makes daily reports to comptroller, showing amounts of cash received, disbursed and on-hand	All luxury hotels
10. Makes out bills when guests check out	All luxury hotels
13. Turns cash over to the audit department	All luxury hotels
14. Maintains the amount of cash needed in the cash drawer	All luxury hotels
1. Receives, sorts and posts charge slips in ledger	All non-luxury hotels
3. Receives payment from guests	All non-luxury hotels

No. 10. Makes out bills when guests check out

No. 13. Turns cash over to the audit department

No. 14. Maintains the amount of cash needed in the cash drawer

Further analysis of Table 6 reveals that two tasks were performed by cashiers regularly in all non-luxury hotels. They are:

No. 1. Receives, sorts and posts charge slips in ledger

No. 3. Receives payment from guests

It was observed that certain tasks were common to both job categories and were performed occasionally in the majority of the hotels.

Table 7 is a summary of the seven tasks which are common to both room clerk and cashier, as reported by the observer, employee and supervisor.

The previous Tables 1-6 have presented task information based on just the regularly performed tasks for room clerk and cashier.

The tables showed that 25% of room clerk tasks were not performed regularly in any hotel; that 12 1/2% were performed regularly in only one hotel, resulting in a total of 37 1/2%, which represented 15 of the 40 room clerk tasks that were performed regularly in one or no hotels.

Tables 1-6 also showed that 19% of cashier tasks were not performed regularly in any hotel; that 15% were performed in only one hotel, resulting in a total of 34%, which represented 11 of the 32 cashier tasks that were performed regularly in one or no hotels.

Since not all tasks are done regularly, it was deemed important to determine

TABLE 7

SUMMARY OF SEVEN COMMON TASKS IN THE NINE HOTELS*

Task	Room Clerk Task Number	Number of Hotels in Which Tasks are Performed	Cashier Task Number	Number of Hotels in Which Tasks are Performed
1. Receives room key from guest	12	9	30	8
2. Arranges registration desk so that it is neat	22	9	22	9
3. Directs customer's attention to displays of maps and places of interest	25	8	23	8
4. Supplies guest information on advertised services and facilities	28	9	24	8
5. Gives directions to guest	35	9	16	9
6. Adjusts guest's complaints about rooms or services	36	8	17	5
7. Makes suggestions to guests for entertainment and sight-seeing	38	9	19	8

* O = Observer
E = Employee
S = Supervisor

the extent of agreement among respondents as reported by the observer, employee and supervisor within each of the hotels. The Kendall's coefficient of concordance was the statistic used to measure agreement.

Table 8 shows agreement with respect to task frequency among respondents for room clerk and cashier tasks respectively as reported by all hotels.

With respect to room clerk tasks, Table 8 shows there was agreement on tasks frequency performance among hotels responding, since W exceeds .5 in each hotel.

The findings revealed that hotel seven showed the most agreement among observers, employees and supervisors concerning frequency of task performance by room clerks. While hotels three and five respectively revealed the next highest measure of agreement; hotels six and one were third from highest in agreement concerning frequency of task performance by room clerks. Hotels two, four and eight respectively were next to lowest in agreement, and hotel number nine was the hotel with least agreement among observers, employees and supervisors regarding frequency of task performance by room clerks.

Table 8 also shows there was agreement on task frequency with respect to cashiers in seven of the nine hotels. One hotel was borderline between agreement and disagreement. Another hotel showed disagreement. Hotel six showed the most agreement among observers, employees and supervisors concerning frequency of task performance by cashiers. While hotels three, two and one respectively revealed the next highest measure of agreement, hotel five was fifth in rank of

TABLE 8

MEASURE OF AGREEMENT ON ROOM CLERK AND CASHIER TASKS FREQUENCY AMONG OBSERVERS, EMPLOYEES AND SUPERVISORS FOR EACH OF THE NINE HOTELS*

Hotel Code Number	Room Clerk Task	Hotel Type (Luxury N=3) (Non-Luxury N=6)	Cashier Task	Hotel Type (Luxury N=3) (Non-Luxury N=6)
1	W = .6854	Non-Luxury	W = .8245	Non-Luxury
2	W = .6442	Non-Luxury	W = .8360	Non-Luxury
3	W = .7459	Non-Luxury	W = .8363*	Non-Luxury
4	W = . 6494	Luxury	W = .5488*	Luxury
5	W = .7082	Luxury	W = .7461*	Luxury
6	W = .6986	Non-Luxury	W = .8537	Non-Luxury
7	W = .8246	Luxury	W = .6834	Luxury
8	W = .6328	Non-Luxury	W = .5078	Non-Luxury
9	W = .6064	Non-Luxury	W = .4400	Non-Luxury

* For Hotels 3, 4, 5 only 24 items were responded to for the cashier tasks
Number of room clerk tasks = 40
Number of cashier tasks = 32

* W = Kendall's Coefficient of Concordance
0 = total disagreement
1 = total agreement

the nine hotels in respect to agreement on frequency of task performance by cashiers. Hotels seven, four and eight respectively were next to the lowest in agreement, and hotel number nine was the hotel with least agreement among observers, employees and supervisors regarding frequency of task performance by room clerks.

Cashier and room clerk task frequency of performance with respect to agreement among observers, employees and supervisors will now be discussed with respect to luxury and non-luxury hotel classification.

With respect to number of luxury and number of non-luxury hotels with highest agreement there was agreement on task frequency in all three luxury hotels, with one considerably higher than the other two. There was agreement on task frequency in all six non-luxury hotels, with one being considerably higher than the others.

To measure the relationship between the luxury and non-luxury hotel responses on the frequency of task performance Kendall's rank correlation coefficient was used. A value of .5359 was obtained for room clerk task frequency of performance and .5943 for cashier task frequency of performance. Therefore, the luxury and non-luxury hotels agreed positively, to some extent, with respect to the frequency of cashier and room clerk task performance. The range of values allowable for Kendall's rank correlation coefficient is between -1 and +1.

Table 9 identifies which of the respondents: observers, employees and supervisors agreed least with the majority opinion.

TABLE 9

CORRELATION OF EACH RESPONDENT WITH CONSENSUS ON FREQUENCY OF TASK PERFORMANCE

Hotel	Room Clerk O.	Room Clerk E.	Room Clerk S.	Respondent Agreeing Least	Hotel	Cashier O.	Cashier E.	Cashier S.	Respondent Agreeing Least
1	.71	.84	.81	O	1	.96	.92	.81	S
2	.85	.76	.73	S	2	.91	.88	.91	E
3	.80	.85	.91	O	3	.87	.89	.95	O
4	.95	.87	.49	S	4	.91	.72	.51	S
5	.90	.82	.73	S	5	.88	.75	.88	E
6	.88	.85	.74	S	6	.93	.88	.89	E
7	.93	.81	.93	E	7	.87	.62	.82	E
8	.80	.80	.75	S	8	.62	.77	.69	O
9	.80	.75	.70	S	9	.73	.63	.60	S

Table 9 shows that of the observers, employees and supervisors responding for nine hotels the supervisors of six hotels were in least agreement concerning task frequency of performance by room clerks. In two hotels the observer agreed least, and in one hotel the employee was the respondent showing least agreement concerning frequency of task performance by room clerks.

Further analysis of Table 9 showed that of the observers, employees and supervisors responding, the supervisors in four hotels and the employees in four other hotels showed the least agreement concerning task frequency of performance by cashiers. In one hotel the observer was the respondent showing least agreement concerning frequency of task performance by cashiers.

Agreement in hotels and among respondents may be affected by the fact that both job categories are involved in the tasks being performed. This is discussed in Chapter V.

The data collected also revealed the reaction of the observer, employee and supervisor to the importance of the task performed.

When developing curriculum for the hotel and motel industry it is useful to know which tasks were considered most important.

Note: each hotel had three respondents. When a task was reported as being of great importance, all three respondents for that hotel agreed that the task was of great importance.

Table 10 presents all 40 room clerk tasks and shows the number of hotels responding that reported the task as being of great importance.

TABLE 10

IMPORTANCE OF ROOM CLERK TASK PERFORMANCE ACCORDING TO NUMBER OF HOTELS RESPONDING*

Task	Number of Hotels (N=9)
1. Rents and assigns rooms to guest	9
2. Greets guests and asks what type of room is desired	7
3. Quotes prices of rooms, trying to rent more expensive ones first	4
4. Assists guests in registering for rooms	7
5. Writes room number on registration card	9
6. Summons bellman and gives him room key	6
7. Gives bellman any special instructions	5
8. Maintains room availability count	8
9. Reserves rooms for guests by consulting reservation file	7
10. Arranges transfer of registered guest to other rooms, making out a transfer slip in duplicate	4
11. Checks out guests	4
12. Receives room key from guest	2
13. Time stamps registration card	6
14. Makes out forms for advanced payment	4
15. Maintains records of guests' charges, etc.	3

TABLE 10 (Continued)

Task	Number of Hotels (N=9)
16. Sorts mail	4
17. Informs guest of services available	6
18. Makes advanced reservations	6
19. Mails reservations acknowledgement to future guests	1
20. Shows and sells room accommodations	3
21. Transmits and receives messages by phone, teletypewriter	5
22. Arranges registration desk so that it is neat	6
23. Wears uniform in accordance with the policies of the hotel or motel	1
24. Displays candy and cigarettes in a convenient place	0
25. Directs customer's attention to displays of maps and places of interest	0
26. Displays posters of special events in the community for tourist to see	0
27. Calls guests' attention to directional signs	2
28. Supplies guest information on advertised services and facilities	5
29. Informs hotel and motel personnel involved about advertised services and facilities	1
30. Reads own and competitors newspapers or trade journals	0
31. Points out advertised services or facilities to guest	3

TABLE 10 (Continued)

Task	Number of Hotels (N=9)
32. Keeps informed of competition prices and promotional campaigns	0
33. Promotes the hotel or motel by giving immediate and courteous service to guests	9
34. Offers guests free copies of community events brochures or entertainment brochures	2
35. Gives directions to guest	5
36. Adjusts guests' complaints about rooms or services	5
37. Authorizes guests bank checks	0
38. Makes suggestions to guests for entertainment and sightseeing	2
39. Suggests good restaurants to guests	3
40. Takes reservations by phone, mail and telegraph	7

The following tasks were of great importance in nine hotels:

No. 1. Rents and assigns rooms to guest

No. 5. Writes room number on registration card

No. 33. Promotes the hotel or motel by giving immediate and courteous service to guests

Task No. 4, Maintains room availability count, was of great importance in eight hotels. The findings further revealed that the following tasks were of great importance in seven hotels responding:

No. 2. Greets guests and asks what type of room is desired

No. 4. Assists guests in registering for rooms

No. 9. Reserves rooms for guests by consulting reservation file

No. 40. Takes reservations by phone, mail and telegraph

Room clerk Tasks No. 6, 13, 17, 18 and 22 were found to be of great importance in six hotels. They are as follows:

No. 6. Summons bellman and gives him room key

No. 13. Time stamps registration card

No. 17. Informs guest of services available

No. 18. Makes advanced reservations

No. 22. Arranges registration desk so that it is neat

Continued analysis of Table 10 showed that room clerk Tasks No. 7, 21, 28, 35 and 36 were of great importance in five hotels. They are as follows:

No. 7. Gives bellman any special instructions

No. 21. Transmits and receives messages by phone, teletypewriter

No. 28. Supplies guest information on advertised services and facilities

No. 35. Gives directions to guest

No. 36. Adjusts guests' complaints about rooms or services

Further analysis of the table showed five room clerk tasks to be of great importance in four hotels. They are as follows:

No. 3. Quotes prices of rooms, trying to rent more expensive ones first

No. 10. Arranges transfer of registered guest to other rooms, making out a transfer slip in duplicate

No. 11. Checks out guests

No. 14. Makes out forms for advanced payment

No. 16. Sorts mail

The following room clerk tasks were of great importance in only three hotels:

No. 15. Maintains records of guests' charges, etc.

No. 20. Shows and sells room accommodations

No. 31. Points out advertised services or facilities to guest

No. 39. Suggests good restaurants to guests

Tasks No. 12, 27, 34 and 38 were considered to be of great importance in only two hotels. They are as follows:

No. 12. Receives room key from guest

No. 27. Calls guests' attention to directional signs

No. 34. Offers guests free copies of community events brochures or entertainment brochures

No. 38. Makes suggestions to guests for entertainment and sight-seeing

Tasks No. 19, 23 and 29 were of great importance in only one hotel and Tasks No. 24, 25, 26, 30, 32 and 37 were considered by no hotels to be of great importance. They are as follows:

No. 19. Mails reservations acknowledgement to future guests

No. 23. Wears uniform in accordance with the policies of the hotel or motel

No. 29. Informs hotel and motel personnel involved about advertised services and facilities

No. 24. Displays candy and cigarettes in a convenient place

No. 25. Directs customer's attention to displays of maps and places of interest

No. 26. Displays posters of special events in the community for tourist to see

No. 30. Reads own and competitors newspapers or trade journals

No. 32. Keeps informed of competition prices and promotional campaigns

No. 37. Authorizes guests bank checks

Table 11 is a summary of the 13 most important room clerk tasks which include those tasks rated as of great importance by six or more of the hotels.

In summary, Tasks:

No. 1. Rents and assigns rooms to guest

No. 5. Writes room number on registration card

No. 33. Promotes hotel or motel by giving immediate and courteous service to guests

were considered by all nine hotels to be of great importance.

The next group of tables presented in Chapter IV were devoted to describing the importance of cashier task performance.

Table 12 shows the tasks performed by cashiers considered of great importance according to number of hotels reporting.

Of the 32 tasks rated, Tasks No. 1, 3 and 4 were reported by all hotels to be of great importance. They are as follows:

No. 1. Receives, sorts and posts charge slips in ledger

No. 3. Receives payment from guest

No. 4. Makes out receipted bills for guests

Cashier Task No. 14, Maintains the amount of cash needed in the cash drawer, was rated by eight hotels as being of great importance to job performance.

Continued analysis of Table 12 revealed that Tasks No. 7 and No. 13 showed that seven hotels believed these tasks were of great importance.

No. 7. Cashes travelers checks, money orders and makes change

TABLE 11

SUMMARY OF MOST IMPORTANT TASKS PERFORMED BY ROOM CLERKS ACCORDING TO NUMBER OF HOTELS RESPONDING

Task Rank	Task	Number of Hotels (N=9)
1	1. Rents and assigns rooms to guest	9
2	5. Writes room number on registration card	9
3	33. Promotes hotel or motel by giving immediate and courteous service to guests	9
4	8. Maintains room availability count	8
5	2. Greets guests and asks what type of room is desired	7
6	4. Assists guests in registering for room	7
7	9. Reserves rooms for guests by consulting reservation file	7
8	40. Takes reservations by phone, mail and telegraph	7
9	6. Summons bellman and gives him room key	6
10	13. Time stamps registration card	6
11	17. Informs guest of services available	6
12	18. Makes advanced reservations	6
13	22. Arranges registration desk so that it is neat	6

TABLE 12

IMPORTANCE OF CASHIER TASK PERFORMANCE
ACCORDING TO NUMBER OF HOTELS RESPONDING

Task	Number of Hotels (N=9)
1. Receives, sorts and posts charge slips in ledger	9
2. Files charge slips	5
3. Receives payment from guests	9
4. Makes out receipted bills for guests	9
5. Makes authorized disbursements for C.O.D. and similar items	1
6. Cashes authorized checks for guests	5
7. Cashes travelers checks, money orders and makes change	7
8. Makes daily reports to comptroller, showing amounts of cash received, disbursed and on-hand	6
9. Receives and stores guests' valuables in safe or safe deposit boxes	1
10. Makes out bills when guests check out	6
11. Relieves switchboard operator	2
12. Assists the room clerk during rush periods	4
13. Turns cash over to the audit department	7
14. Maintains the amount of cash needed in the cash drawer	8
15. Informs dining room or switchboard operator of guests who have paid in advance for follow-up on meal and telephone call charges	2

TABLE 12 (Continued)

Task	Number of Hotels (N=9)
16. Gives directions to guests	3
17. Adjusts guests' complaints about rooms or services	1
18. Authorizes guests' bank checks	1
19. Makes suggestions to guests for entertainment and sightseeing	2
20. Suggests good restaurant to guest	3
21. Takes reservations by phone, mail and telegraph	2
22. Arranges registration desk so that it is neat--never cluttered	3
23. Directs guests' attention to displays of maps and places of interest	1
24. Supplies guest information on advertised services and facilities	3
25. Records charges for local and long distance calls when guests check out	6
26. Makes note of guest making unusual charges	2
27. Receives and makes voucher for city ledger accounts	3
28. Verifies name of guest from ledger with any charge having that guest's name	3
29. Notifies registration if guest decides to extend stay	2
30. Receives key from guest	1
31. Receives report from night audit	0
32. Posts all charges to guest's account	6

No. 13. Turns cash over to the audit department

Cashier Tasks No. 8, 10, 25 and 32 were found to be of great importance in six hotels. These tasks are as follows:

No. 8. Makes daily reports to comptroller, showing amounts of cash received, disbursed and on-hand

No. 10. Makes out bills when guests check out

No. 25. Records charges for local and long distance calls when guests check out

No. 32. Posts all charges to guest's account

Further examination of Table 12 showed that the following tasks were considered of great importance to cashiers by five hotels:

No. 2. Files charge slips

No. 6. Makes authorized disbursements for C.O.D. and similar items

Task No. 12, Assists the room clerk during rush periods, was considered of great importance to cashiers by four hotels.

Looking at the next group of tasks which were considered of great importance to cashier task performance, it was revealed that Tasks No. 16, 20, 22, 24, 27 and 28 were rated by three hotels while Tasks No. 11, 15, 19, 21, 26 and 29 were rated by two hotels; and Tasks No. 5, 9, 17, 18, 23 and 30 were considered of great importance by only one hotel. They are as follows:

No. 16. Gives directions to guests

No. 20. Suggests good restaurant to guest

No. 22. Arranges registration desk so that it is neat--never cluttered

No. 24. Supplies guest information on advertised services and facilities

No. 27. Receives and makes voucher for city ledger accounts

No. 28. Verifies name of guest from ledger with any charge having that guest's name

No. 11. Relieves switchboard operator

No. 15. Informs dining room or switchboard operator of guests who have paid in advance for follow-up on meal and telephone call charges

No. 19. Makes suggestions to guests for entertainment and sightseeing

No. 21. Takes reservations by phone, mail and telegraph

No. 26. Makes note of guest making unusual charges

No. 29. Notifies registration if guest decides to extend stay

No. 5. Makes authorized disbursements for C.O.D. and similar items

No. 9. Receives and stores guests' valuables in safe or safe deposit boxes

No. 17. Adjusts guests' complaints about rooms or services

No. 18. Authorizes guests' bank checks

No. 23. Directs guests' attention to displays of maps and places of interest

No. 30. Receives key from guest

An analysis showed that Task No. 31, Receives report from night audit, was not of great importance to any hotel reporting. This task was not performed by cashiers and this researcher found that the night audit reports were forwarded to accounting.

Table 13 is a summary of the most important tasks performed by cashiers according to hotels responding.

In summary, the most important tasks performed by cashiers in all hotels are tasks:

No. 1. Receives, sorts and posts charge slips in ledger

No. 3. Receives payment from guests

No. 4. Makes out receipted bills for guests

The measure of agreement among respondents with respect to the importance of task performance by cashiers and room clerks will now be discussed. The measure of agreement was not determined for each hotel but the importance of task performance was determined for the hotels collectively.

Table 14 shows the agreement with respect to task importance among respondents for room clerk and cashier tasks respectively as reported over all hotels.

With respect to measuring agreement between luxury and non-luxury hotels, Kendall's rank correlation coefficient was used. A value of .5294 was obtained

TABLE 13

SUMMARY OF MOST IMPORTANT TASKS PERFORMED BY CASHIERS ACCORDING TO NUMBER OF HOTELS RESPONDING

Task Rank	Task	Number of Hotels (N=9)
1	1. Receives, sorts and posts charge slips in ledger	9
2	3. Receives payment from guest	9
3	4. Makes out receipted bills for guests	9
4	14. Maintains the amount of cash needed in the cash drawer	8
5	7. Cashes travelers checks, money orders and makes change	7
6	13. Turns cash over to the audit department	6
7	8. Makes daily reports to comptroller, showing amounts of cash received, disbursed and on-hand	6
8	10. Makes out bills when guests check out	6
9	25. Records charges for local and long distance calls when guests check out	6
10	32. Posts all charges to guest's account	6

TABLE 14

MEASURE OF AGREEMENT ON ROOM CLERK AND CASHIER TASKS IMPORTANCE AMONG OBSERVERS, EMPLOYEES AND SUPERVISORS OVER ALL HOTELS*

Job Category	Measure of Agreement	Number of Tasks
Room Clerk	W = .8631	40
Cashier	W = .8541	32

* W = Kendall's Coefficient of Concordance
0 = total disagreement
1 = total agreement

for room clerk task importance and a value of .5585 was obtained for cashier task importance. Therefore, the luxury and non-luxury hotels were somewhat in agreement with respect to importance of cashier and room clerk task performance.

Another purpose of the study was to determine competencies for the job categories of room clerk and cashier. Competencies necessary for performance of room clerk and cashier were identified by interviewing five executives in hotels and motels in Philadelphia.

The researcher had personal interviews with five hotel executives who qualified as experts in hotel front office procedures. They are as follows: the resident manager of the Warwick Hotel, the resident manager of the Philadelphia Sheraton, the manager of the Holiday Inn-Midtown, the front office manager of the Benjamin Franklin Hotel and the front office manager of the Bellevue Stratford Hotel.

Comments were received from each individual interviewed relative to the following questions:

1. What competencies (skills, knowledges, and attitudes) are important at job entry-level for room clerks and cashiers?
2. What future trends are foreseen in the hotel-motel industry that should affect training and employment for the next five years?
3. How will these trends affect the hotel-motel industry within the next five years?

Question 1. The five managers interviewed all reported that the two most important competencies required of room clerks were (1) the ability to sell the property and (2) the ability to project a positive attitude toward the public. One resident manager stated that an ability to learn was necessary in this job category. For example, he must be able to learn location and arrangement of rooms and the hotel layout so that he may present the hotel and rooms to the customer more effectively.

A front office manager revealed that knowledge of the equipment in the rooms and their location in the building was essential information for room clerks when performing their duties effectively. All five managers felt very strongly that appearance was most important and saw the room clerk as the one individual who exercised the most influence over the customer's impression of the hotel at the beginning.

There was unanimity among managers that courtesy, a willingness to offer service and a positive attitude toward the customer were competencies essential to job performance in both job categories of room clerk and cashier.

At least one manager pointed out the importance of the room clerk and cashier being capable of making decisions that would be consistent with management directives.

A consensus of the five experts revealed that competencies for cashier were the same as for room clerk with the addition of knowledge of accounting and machines, or the ability to learn these duties.

In summary, all interviewed reported that the competencies required for the room clerk are also required for the cashier, which included abilities in communicative skills, projecting a positive attitude toward the public, to make decisions under all types of conditions, and the ability to employ basic sales techniques that are service oriented. All managers expressed the view that cashiers should be competent when working with numbers, machines and handling money correctly. All felt that job performance was effective in both categories only when emphasis was placed on service and good customer relations.

Question 2. As to forecasting, the five managers revealed trends foreseen in the hotel-motel industry that may affect training and employment for the next five years. All managers reported an expected increase in the need for room clerks and cashiers based on the expected large volume of business generated by the Bi-centennial activities.

Three out of the five managers interviewed see the most important trend in the industry affecting training as the increased use of computers. At least one resident manager stated that training courses in the operation of computerized reservation systems are going to be of great importance and should be incorporated into training programs.

One manager suggested that room clerks and cashiers will, in the near future, be required to be competent in speaking one or more foreign language. He felt that French, Spanish and German were most needed because of the increase in the volume of customers from overseas. He emphasized that the recent

and planned openings of hotels in foreign countries would place a demand on the industry for individuals with language competency.

Question 3. All managers reported that the trend in the industry which represents the greatest change is the growth of small, 200 or less, room properties designed for fast computerized operation.

All five managers revealed their opinions of how these trends would affect the industry for the next five years. They believe that service to the customer will become less personal and agreed that the industry will become more automated at the cost of personal service to the consumer.

In summary, the five hotel experts revealed that the requirement for personnel in the job categories of room clerk and cashier would greatly increase in the next five years. The opinion that a trend toward more automation would be an important influence, bringing about a change and greater growth within the industry, was prevalent. All agreed that the industry was thriving but changing from the traditional role of large service oriented properties to the more computerized nonpersonal hotel or motel.

The researcher requested information concerning the employment opportunities to determine the potential labor market for the job categories of room clerk and cashier from the following sources:

1. The Labor Market Data Bank, School of Business, Temple University
2. Philadelphia Hotel and Motel Association

3. The Bureau of Employment Security, Philadelphia Office

4. The Chamber of Commerce of Greater Philadelphia

5. The Managers of nine hotels involved in this study

A spokesman for the Labor Market Data Bank at Temple University reported that the need for hotel front office clerks in the Philadelphia Labor Market Area would increase from 1,614 in 1970 to 2,552 by 1980.

A representative of the Philadelphia Hotel and Motel Association predicted that the association expects its members to increase their requirements for room clerks and cashiers before 1976. At least one hotel front office manager predicted a 100% increase in staff in the room clerk and cashier job categories by 1976.

The Bureau of Employment Security, Philadelphia Office, did not have labor market data concerning the specific job categories of room clerk and cashier.

The Chamber of Commerce of Greater Philadelphia had no information concerning the employment opportunities for these job categories.

The nine hotel executives in the hotels involved in the study each completed a top management interview guide which asked the following questions:

1. What do you believe will be the turnover rate in this occupational area through 1980?

    a. Do you feel that there will be an increased need in this occupational area? Please indicate your reaction to the need for additional personnel in this occupational area

between 1973 and 1980 by selecting one of the six choices below.

b. What influence will the Bi-centennial generate as far as new jobs in this occupational area is concerned?

2. What is your responsibility for selection of incoming personnel?

3. From your experiences, which type of individual would you be most likely to employ?

4. Would a coop-training program in these two occupational areas be appropriate in high school?

Eight managers reported that they expected a greatly increased need for personnel in the job categories of room clerk and cashier. One felt that there would be a slight increase. A majority of the managers believed that the Bi-centennial will generate potential for an increase in the labor market for the job categories of room clerk and cashier.

All managers were involved in the selection of room clerks and cashiers and the majority reported that they would hire a high school graduate and strongly recommended that cooperative training be provided for these job categories.

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

The purpose of this study was to determine tasks performed by hotel or motel room clerks and hotel or motel cashiers. How often these tasks were performed and how important the observer, employee and supervisor perceived each task was also determined.

Another purpose of the study was to show results based upon observation of the employee performing the task, and the method of interviewing used by Crawford (1967), thus utilizing both research methods of task collection as performed by hotel or motel room clerks and hotel or motel cashiers.

The study also sought to determine answers to the following questions:

1. Does the fact that the hotel or motel is a luxury or non-luxury operation influence the tasks performed by room clerks and cashiers?
2. Which tasks associated with room clerks are also associated with cashiers?
3. Should tasks associated with room clerks and cashiers be developed in a secondary or post-secondary vocational education program?

Data was collected from 27 respondents composed of observers, employees and supervisors in nine hotels. To determine actual tasks performed by hotel or

motel room clerks and hotel or motel cashiers, the respondents completed the task collection interview guide (see Appendices A and B, pages 86 and 89) for each job category, revealing his reaction to the frequency and importance of the task performance. Five experts in hotel front office management were interviewed and competencies necessary for task performance by room clerks according to their opinions were determined. The findings are summarized as follows:

1. The observer, employees and supervisors reported that there were certain tasks which were performed regularly by room clerks and cashiers.
2. All hotels reported that certain tasks were of great importance for room clerks and cashiers.
3. All the hotels indicated agreement among the three respondents on the frequency of tasks performed by room clerks and eight hotels indicated agreement among those performed by cashiers.
4. There was agreement among the three respondents on the importance of tasks performed by room clerks and cashiers as viewed by all hotels responding.
5. The findings revealed that there were seven tasks associated with room clerks that were also associated with cashiers.
6. The findings revealed that certain tasks could be identified as being performed regularly by room clerks and cashiers as a function of the

hotel being luxury or non-luxury.

7. Luxury and non-luxury hotels agreed to some extent with respect to the regular, occasional, and infrequent occurrence of room clerk and cashier tasks.

8. Interviews with five hotel experts revealed their views on the competencies necessary for the performance of room clerk and cashier tasks.

9. Job market information revealed that there will be an increase in the need for the job categories of room clerk and cashier over the next five years.

The researcher realizing the importance of basing curricular decisions on data collected by the observation method for task analysis, spent time in each hotel or motel observing the room clerk and cashier. Using the task collection interview guide, the observer proceeded to determine the frequency and importance of the task performance for both job categories.

It was immediately realized how important the frequency of task performance would be to curricular writers. The findings revealed that 25% of the room clerk tasks were not performed regularly in any hotel; that $12^1/2$% were performed regularly in only one hotel, resulting in a total of $37^1/2$%, which represented 15 of the 40 room clerk tasks being performed regularly in either one or no hotels (see Table 1, page 28).

The findings also revealed that 19% of cashier tasks were not performed regularly in any hotel; that 15% were performed in only one hotel, resulting in a

total of 34% which represent 11 of the 32 cashier tasks that are only done regularly in one or no hotels (see Table 4, page 36).

All but nine of the 40 room clerk tasks were considered to be of great importance in at least one of the nine hotels. A summary of the 13 most important room clerk tasks revealed that Tasks No. 1, 5 and 33 were rated as of great importance by six hotels. These room clerk tasks were also reported among the most frequently performed tasks.

All but one of the 32 cashier tasks listed were considered to be of great importance in at least one of nine hotels.

Data analysis showed that cashier Task No. 31, Receives report from night audit, was not performed by cashiers, and this researcher found that the night audit reports were forwarded to accounting by the night auditor.

A summary of the most important cashier tasks (see Table 10, page 50) revealed that Tasks No. 1, 3 and 4 were rated as of great importance by all nine hotels or motels reporting. These same cashier tasks were also reported among the most frequently performed tasks (see Table 5, page 41).

There was agreement among hotels responding on task frequency of performance for room clerk and cashier tasks. All of the nine hotels indicated agreement among the three respondents on the frequency of room clerk tasks performed and eight hotels indicated agreement as to the frequency of task performance by cashiers.

Table 14 (page 64) showed that there was a measure of agreement on room clerk and cashier task importance among observers, employees and supervisors over

all hotels.

An interesting outcome of the findings was the discovery that seven tasks taken from Volume IV of the study, "A Competency Pattern Approach to Curriculum Construction in Distributive Teacher Education" (Crawford, 1967) were common to both room clerk and cashier task performance. Room clerk Tasks No. 12, 22, 25, 28, 35, 36 and 38 are common to cashier Tasks No. 30, 22, 23, 24, 16, 17 and 19 respectively (see Table 7, page 44).

Of the 40 room clerk tasks, certain ones were found to be performed regularly by both luxury and non-luxury hotels or motels, and certain tasks were performed as a function of the hotel being luxury or non-luxury. Room clerk Tasks No. 13 and No. 33 were reported as being performed regularly by all hotels. Tasks No. 1 and No. 5 were performed regularly by room clerks in all non-luxury hotels and Tasks No. 4 and No. 22 were performed by room clerks in all luxury hotels (see Table 1, page 28).

Of all the 32 cashier tasks performed, none were reported as being performed regularly by all nine hotels. Tasks No. 8, 10, 13 and 14 were performed regularly by cashiers in all luxury hotels, and Tasks No. 1 and No. 3 were performed regularly by cashiers in all non-luxury hotels (see Table 4, page 36).

Table 8 (page 46) showed that there was agreement with respect to the degree of occurrence of all room clerk and cashier tasks.

The five experts in hotel front office procedure reported that, in their opinion, the competencies required for performance of the room clerk tasks are

also required for the cashier, which included:

a. Abilities in communicative skills

(1) Ability to sell the hotel or service

b. Positive attitude toward the public

(1) Proper appearance

(2) Courtesy and willingness to offer service

c. Working with numbers, machines and handling money

(1) Abilities to learn skills and duties required (i.e., accounting and office machines skills)

d. Ability to make decisions which are in keeping with management policy

All experts felt job performance was effective in both categories only when emphasis was placed on service and good customer relations.

The findings included job market information as the last area reviewed. The five hotel experts revealed that the requirement for personnel in the job categories of room clerk and cashier would greatly increase over the next five years. The Labor Market Data Bank at Temple University reported that the need for hotel front office clerks in the Philadelphia Labor Market Area would increase from 1,614 in 1970 to 2,552 by 1980. The Bureau of Employment Security and the Chamber of Commerce of Greater Philadelphia had no information concerning the employment opportunities for the specific job categories of hotel or motel room clerks and hotel or motel cashiers.

CONCLUSIONS

The analysis of the findings of this study lead to the following conclusions.

A. Task Analysis

1. Room clerk and cashier task lists taken from Volume IV, "A Competency Pattern Approach to Curriculum Construction in Distributive Teacher Education" (Crawford, 1967) were generally found to be appropriate as a basis for this study. However, the task analysis observation method confirmed and varified the Crawford findings, which prior to this study, were in the realm of conjecture.

2. The requirement for more service by the hotel guests in luxury hotels caused certain tasks to be performed more frequently and were more important. Other tasks in non-luxury hotels required less service and were performed more frequently and considered more important.

3. Room clerk Tasks No. 13, Time stamps registration card and No. 33, Promotes the hotel or motel by giving immediate and courteous service to guest, were performed more frequently. However, Tasks No. 1, Rents and assigns room, No. 3, Quotes prices of rooms, trying to rent more expensive ones first, and No. 33, were considered of great importance. Cashier Tasks No. 1, Receives, sorts and posts charge slips in ledger, No. 3, Receives payment from guests, and No. 14, Maintains the amount of cash needed in the cash drawer, were performed more frequently. However, Tasks No. 1, 3 and No. 4, Makes out receipted bill for guests, were considered most important. Thus, the tasks performed more frequently in the most hotels are not always considered to be of great importance.

4. Observation as a method revealed agreement as to task frequency of performance and importance when compared to interviewing employees and supervisors.

B. Implications for Curriculum Development

1. The observation method for task analysis involving the observing of the worker performing the task should be utilized as a basis for vocational education curriculum input.

2. Task performance in luxury or non-luxury hotels did not warrant a variation in the development of curriculum for room clerk and cashier training.

3. When developing curriculum for the hotel and motel industry, it is important to know which tasks are performed most frequently and are considered of great importance.

C. Implications Based on Experts' Opinions

1. Of competencies felt to be necessary for job performance by room clerks and cashiers according to the five hotel experts, the following competencies have implications for curriculum development.

a. Ability in communicative skills

(1) Ability to sell the hotel or service

b. Positive attitude toward the public

(1) Proper appearance

(2) Courtesy and willingness to offer service

c. Working with numbers, machines and handling money

(1) Abilities to learn skills and duties required (i.e., accounting and office machine skills)

2. Although room clerk and cashier tasks are stated differently, a consensus by the five hotel experts revealed that, in their opinion, competencies for task performance by room clerks were the same as for cashiers with the addition of a knowledge of accounting and machines, or the ability to learn these skills. At least one hotel manager stated that the jobs were interchangeable in the hotel he managed.

3. The requirements for personnel in the job categories of room clerk and cashier will greatly increase in the next five years.

4. The hotel and motel industry is changing from the traditional role of large service oriented properties to the more computerized, non-personal hotel.

5. Curriculum development for room clerks and cashiers should include skills development in how to use computerized reservation equipment and instruction in foreign language.

IMPLICATIONS

1. The observation method for task analysis should be employed when determining content for courses taught in distributive education cooperative programs on the secondary and post-secondary levels.

2. Curriculum specialists should place more emphasis on curriculum development designed to provide for the training of hotel or motel room clerks and cashiers.

3. Curricular decisions concerning the development of programs for the hotel/motel industry should be based on the observation method for task analysis of the occupations, and the competencies should be determined by an advisory committee from the hotel/motel industry.

RECOMMENDATIONS

The result of this research led to the following recommendations:

1. That the distributive education programs developed for the job categories of room clerk and cashier should be designed for post-secondary vocational education.

2. The distributive education curriculum should be expanded to include training in the job categories of hotel or motel room clerks and hotel or motel cashiers. The training programs should include skills in how to use computerized reservation equipment and instruction in foreign language.

3. The training of room clerks and cashiers should include work training or the cooperative method of distributive education teaching.

4. That the distributive education vocational service area employ the observation method for task analysis when making curricular decisions.

5. Studies similar to this one should be conducted in other geographical areas, both foreign and domestic, to determine if there are regional differences in the task analysis of room clerks and cashiers.

6. Room clerks and cashiers should be trained to perform in both job categories.

7. That this study serve as a guide for future research for development of other job classifications within the hotel and motel industry for purposes of curriculum development.

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APPENDICES

APPENDIX A

TASK COLLECTION INTERVIEW GUIDE

Name of Hotel or Motel _____

Date and Day of Observation _____

Experience as a room clerk _____ yrs _____ mos.

Completed by _____

1. Please place the appropriate number in the space provided in the left column to indicate the frequency of task performance: (1) regularly, (2) occasionally, (3) never, or (4) not able to respond.*

   In the column on the right, place the appropriate number to indicate the importance of the task performance: (1) great, (2) some, (3) little, or (4) no.

Occupational Title: Room Clerk

_____	1. Rents and assigns rooms to guest	_____
_____	2. Greets guests and asks what type of room is desired	_____
_____	3. Quotes prices of rooms, trying to rent more expensive ones first	_____
_____	4. Assists guests in registering for rooms	_____
_____	5. Writes room number on registration card	_____
_____	6. Summons bellman and gives him room key	_____
_____	7. Gives bellman any special instructions	_____

* (1) Regularly denotes task is performed five or more times during a normal shift.
(2) Occasionally denotes task is performed less than five times during a normal shift.

_____ 8. Maintains room availability count _____

_____ 9. Reserves rooms for guests by consulting reservation file _____

_____ 10. Arranges transfer of registered guest to other rooms, making out a transfer slip in duplicate _____

_____ 11. Checks out guests _____

_____ 12. Receives room key from guest _____

_____ 13. Time stamps registration card _____

_____ 14. Makes out forms for advanced payment _____

_____ 15. Maintains records of guests' charges, etc. _____

_____ 16. Sorts mail _____

_____ 17. Informs guest of services available _____

_____ 18. Makes advanced reservations _____

_____ 19. Mails reservations acknowledgement to future guests _____

_____ 20. Shows and sells room accommodations _____

_____ 21. Transmits and receives messages by phone, tele-typewriter _____

_____ 22. Arranges registration desk so that it is neat _____

_____ 23. Wears uniform in accordance with the policies of the hotel or motel _____

_____ 24. Displays candy and cigarettes in a convenient place _____

_____ 25. Directs customer's attention to displays of maps and places of interest _____

_____ 26. Displays posters of special events in the community for tourist to see _____

_____ 27. Calls guests' attention to directional signs _____

_____ 28. Supplies guest information on advertised services and facilities _____

_____ 29. Informs hotel and motel personnel involved about advertised services and facilities _____

_____ 30. Reads own and competitors newspapers or trade journals _____

_____ 31. Points out advertised services or facilities to guest _____

_____ 32. Keeps informed of competition prices and promotional campaigns _____

_____ 33. Promotes the hotel or motel by giving immediate and courteous service to guests _____

_____ 34. Offers guests free copies of community events brochures or entertainment brochures _____

_____ 35. Gives directions to guest _____

_____ 36. Adjusts guests' complaints about rooms or services _____

_____ 37. Authorizes guests bank checks _____

_____ 38. Makes suggestions to guests for entertainment and sightseeing _____

_____ 39. Suggests good restaurants to guests _____

_____ 40. Takes reservations by phone, mail and telegraph _____

II. Please list tasks that occur in the performance of this occupational title but have been omitted from the list.

Use the same procedure to rate frequency and importance of performance.

APPENDIX B

TASK COLLECTION INTERVIEW GUIDE

Name of Hotel or Motel _____

Date and Day of Observation _____

Experience as a cashier _____ yrs. _____ mos.

Completed by _____

1. Please place the appropriate number in the space provided in the left column to indicate the frequency of task performance: (1) regularly, (2) occasionally, (3) never, or (4) not able to respond.

   In the column on the right, place the appropriate number to indicate importance of task performance: (1) great, (2) some, (3) little, or (4) no.

Occupational Title: Cashier

_____	1. Receives, sorts and posts charge slips in ledger	_____
_____	2. Files charge slips	_____
_____	3. Receives payment from guests	_____
_____	4. Makes out receipted bills for guests	_____
_____	5. Makes authorized disbursements for C.O.D. and similar items	_____
_____	6. Cashes authorized checks for guests	_____
_____	7. Cashes travelers checks, money orders and makes change	_____
_____	8. Makes daily reports to comptroller, showing amounts of cash received, disbursed and on-hand	_____

_____ 9. Receives and stores guests' valuables in safe or safe deposit boxes _____

_____ 10. Makes out bills when guests check out _____

_____ 11. Relieves switchboard operator _____

_____ 12. Assists the room clerk during rush periods _____

_____ 13. Turns cash over to the audit department _____

_____ 14. Maintains the amount of cash needed in the cash drawer _____

_____ 15. Informs dining room or switchboard operator of guests who have paid in advance for follow-up on meal and telephone call charges _____

_____ 16. Gives directions to guests _____

_____ 17. Adjusts guests' complaints about rooms or services _____

_____ 18. Authorizes guests' bank checks _____

_____ 19. Makes suggestions to guests for entertainment and sightseeing _____

_____ 20. Suggests good restaurant to guest _____

_____ 21. Takes reservations by phone, mail and telegraph _____

_____ 22. Arranges registration desk so that it is neat--never cluttered _____

_____ 23. Directs guests' attention to displays of maps and places of interest _____

_____ 24. Supplies guest information on advertised services and facilities _____

_____ 25. Records charges for local and long distance calls when guests check out _____

_____ 26. Makes note of guest making unusual charges _____

_____ 27. Receives and makes voucher for city ledger accounts _____

_____ 28. Verifies name of guest from ledger with any charge having that guest's name _____

_____ 29. Notifies registration if guest decides to extend stay _____

_____ 30. Receives key from guest _____

_____ 31. Receives report from night audit _____

_____ 32. Posts all charges to guest's account _____

II. Please list tasks that occur in the performance of this occupational title but have been omitted from the list.

Use the same procedure to rate frequency and importance of performance.

APPENDIX C

TASK LISTING SHEET

Occupational Title: _____

Hotel or Motel: _____

No.	Task	Frequency of Performance			Importance		
		O	E	S	O	E	S

O indicates the observer
E indicates the employee
S indicates the supervisor

APPENDIX D

TASK DETAILING SHEET

Occupational Title: _____

Task: _____

Hotel or Motel: _____

No.	Steps in Performing the Task	Categories of Performance

APPENDIX E

HOTELS AND MOTELS SELECTED FOR THE PILOT STUDY

Name	Address
Bellevue Stratford	Broad and Walnut Sts.
Philadelphia International Airport Motel	Industrial Hwy., Rt. 291
Marriott Motor Hotel	City Line Ave. & Monument Rd.
Treadway Mohawk Inn	4200 Roosevelt Blvd.

APPENDIX F

HOTELS AND MOTELS SELECTED FOR THE POPULATION USED IN THE STUDY

Name	Address
Barclay Hotel	18th & Rittenhouse Square
Benjamin Franklin Hotel	9th & Chestnut St.
Holiday Inn--City Line Ave.	City Line Ave. & Monument Rd.
Holiday Inn--Midtown	1305 Walnut St.
Latham Hotel	135 S. 17th St.
Penn Center Inn	Market St. at 20th
Philadelphia Sheraton Hotel	1725 JFK Blvd.
Sheraton Motor Inn	9460 Roosevelt Blvd.
Warwick Hotel	1701 Locust St.

APPENDIX G

(Sample Letter of Introduction)

TEMPLE UNIVERSITY
COLLEGE OF EDUCATION
PHILADELPHIA, PENNSYLVANIA 19122

DIVISION OF
VOCATIONAL EDUCATION

June 28, 1973

Mr. Joseph Egan
General Manager
Warwick Hotel
1701 Locust Street
Philadelphia, Pa. 19103

Dear Mr. Egan:

As a doctoral candidate in Vocational Education at Temple University, I have reached the point in my research requiring actual documentation and support of the study.

The study involves a task analysis and eventual determination of skills needed by individuals working in the job categories of room clerk and cashier.

Mr. John Trent, Resident Manager of the Philadelphia Sheraton has kindly consented to serve as advisor representing the Hotel and Motel Industry in this area. It is at his suggestion that I have contacted you requesting an interview to briefly discuss the study and arrange for permission to work with the front office manager in setting up a short period to observe the jobs mentioned.

Your support of this study, which will lead to the development of a curricula in hotel occupations based on specific skills, will be sincerely appreciated.

Thank you very much for your consideration of this matter. I will contact you within a few days.

Sincerely,

John M. Patterson

John M. Patterson

cc: Mr. John Trent, Resident Mgr.
Philadelphia Sheraton Hotel

Dr. William F. Sassaman, Chairman
Doctoral Committee and Advisor

APPENDIX H

Sheraton Hotel
SHERATON HOTELS AND MOTOR INNS
A WORLDWIDE SERVICE OF ITT

1725 KENNEDY BLVD.
PHILADELPHIA, PA. 19103
TELEPHONE (215) 568-3300

EXECUTIVE OFFICE

February 21, 1973

Mr. John M. Patterson
1327 Spruce Street
Philadelphia, Pennsylvania

Dear Mr. Patterson:

It was a pleasure to meet you and to discuss the opportunities for a young man or woman in the hotel industry.

As I mentioned to you, I feel very strongly that a curriculum on the high school or junior college level would provide us with employees that would fill second-line supervisory jobs and ultimately department head positions.

If you checked with the American Hotel and Motel Association, you would be amazed at the number of employees we will need in 1980. A better example would be Philadelphia in 1976. Estimations have been made by various people, claiming we will need anywhere from 40% to 60% more employees for the Bicentennial celebration. These are jobs that are available due to the increased occupancy in existing hotels, plus new jobs made available because of new hotels opening for the Bicentennial celbration.

I believe that a study to determine task and job market information would aid in developing training programs and curriculums which would help supply us with the qualified people we will need in the hotel industry for future years.

If I can be of any further assistance do not hesitate to call or stop by my office.

Best Regards,

John W. Trent
Resident Manager

JWT/klm

APPENDIX I

NAMES OF HOTELS OR MOTELS AND CLASSIFICATIONS ACCORDING TO LUXURY OR NON-LUXURY

Hotel Code	Name of Hotel or Motel	Classification
1	Philadelphia Sheraton	Non-Luxury
2	Holiday Inn - City Line Ave.	Non-Luxury
3	Penn Center Inn	Non-Luxury
4	The Barclay	Luxury
5	The Latham	Luxury
6	The Benjamin Franklin	Non-Luxury
7	The Warwick	Luxury
8	Holiday Inn - Midtown	Non-Luxury
9	Sheraton Motor Inn (Northeast)	Non-Luxury

APPENDIX J

TYPES OF DATA REPORTED IN THE RESEARCH*

Hotel Type Number of Each	Type of Respondent Number per Hotel	Job Categories Number of Task Each	Task Frequency Code	Task Importance Code
Luxury = 3	O = Observer	Room Clerk = 40	1 = Regularly	1 = Great
Non-Luxury = 6	E = Employee	Cashier = 32	2 = Occasionally	2 = Some
	S = Supervisor		3 = Never	3 = None

* Originally there were four frequencies and importance code numbers but collapsed into three because interpretation of data required only three.

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TITLE: A COMPARISON OF ACADEMIC ACHIEVEMENT IN FULL-TIME AND PART-TIME AREA VOCATIONAL-TECHNICAL HIGH SCHOOLS. FINAL REPORT.

PERSONAL AUTHOR: ZUCCO, DONATO B.

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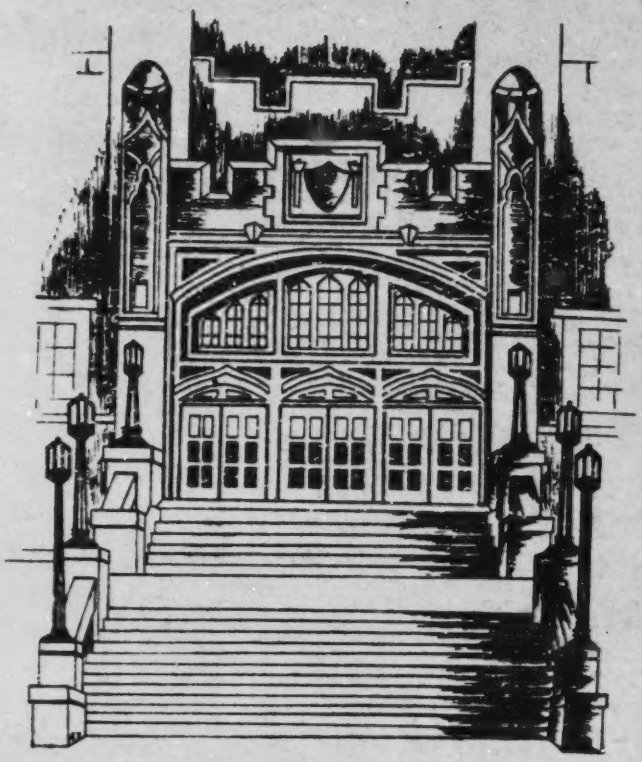
ABSTRACT: THE ACADEMIC ACHIEVEMENT, ACADEMIC PROGRAMS, AND STUDENT OPINION IN FULL-TIME VERSUS PART-TIME AREA VOCATIONAL-TECHNICAL SCHOOLS (AVTS) WAS INVESTIGATED. THE SCHOOL AND COLLEGE ABILITY TEST (SERIES II, FORM B) PROVIDED DATA ABOUT VERBAL AND MATHEMATICAL ABILITY, AND A SEMANTIC DIFFERENTIAL QUESTIONNAIRE WAS CONSTRUCTED TO OBTAIN DATA ABOUT STUDENT OPINIONS. AN EXAMINATION AND ANALYSIS OF THE FOLLOWING SOURCES OF INFORMATION WAS CONDUCTED: PROFESSIONAL LITERATURE, RELATED RESEARCH, CORRESPONDENCE WITH RECOGNIZED AUTHORITIES IN VOCATIONAL-TECHNICAL EDUCATION, AND SCHOOL VISITATIONS. THE STUDY WAS LIMITED TO SENIORS OF THE 1973-74 SCHOOL YEAR ENROLLED IN TRADE AND INDUSTRIAL PROGRAMS IN FOUR SAMPLE SCHOOLS. IT WAS FOUND THAT STUDENTS IN THE FULL-TIME AVTS SCORED SIGNIFICANTLY HIGHER IN VERBAL ABILITY AND MATHEMATICAL ACHIEVEMENT THAN DID THOSE IN THE PART-TIME AVTS. IT WAS ALSO FOUND THAT STUDENTS IN BOTH FULL-TIME AND PART-TIME AVTS HAD MORE FAVORABLE OPINIONS ABOUT THE ITEMS SHOP TEACHER, SHOP COURSE, AND VOCATIONAL-TECHNICAL THAN ABOUT MATH TEACHER, MATHEMATICS, ENGLISH, AND ENGLISH TEACHER. APPENDED TO THE DOCUMENT ARE A SAMPLE OF THE SEMANTIC DIFFERENTIAL QUESTIONNAIRE, THE CORRESPONDENCE FROM THE CONSULTED AUTHORITIES IN VOCATIONAL-TECHNICAL EDUCATION, INFORMATION ABOUT AVTS DEVELOPMENT IN PENNSYLVANIA, AND OTHER INFORMATION RELATED TO THE STUDY. (AUTHOR/NJ)

SPONSORING AGENCY NAME: PENNSYLVANIA RESEARCH COORDINATING UNIT FOR VOCATIONAL EDUCATION, HARRISBURG.

102 484

A Comparison Of Academic Achievement In Full-Time And Part-Time Area Vocational-Technical High Schools



by

Donato B. Zucco

2

FINAL REPORT

A COMPARISON OF ACADEMIC ACHIEVEMENT IN FULL-TIME AND PART-TIME AREA VOCATIONAL-TECHNICAL HIGH SCHOOLS

(Project No. 19-3030)

Donato B. Zucco

UNIVERSITY OF PITTSBURGH

PITTSBURGH, PENNSYLVANIA

1974

PENNSYLVANIA DEPARTMENT OF EDUCATION

BUREAU OF VOCATIONAL EDUCATION

RESEARCH COORDINATING UNIT

A COMPARISON OF ACADEMIC ACHIEVEMENT IN FULL-TIME AND PART-TIME AREA VOCATIONAL-TECHNICAL HIGH SCHOOLS

By

Donato B. Zucco

B. S., University of Pittsburgh, 1962

M. Ed., University of Pittsburgh, 1964

Submitted to the Graduate Faculty in the School of Education in partial fulfillment of the requirements for the degree of Doctor of Philosophy

University of Pittsburgh

1974

3A

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C[illegible] I

INTRODUCTION

A. Background Of The Problem

Changes in the way we live and how we make our living have caused vocational education to become central to the total process of public education.

> The purposes of vocational education have become so enmeshed with the purposes of education in general that we are not justified in thinking of vocational education as a separate and distinct entity set aside from education.
>
> The total educational process is inexorably tied to the work required by society. Both the nature of society and the characteristics of work have changed. In recent years, these changes have been rapid and have magnified the interdependency of work and education. There is no place in the world of work either for the educated person who has not learned to work.
>
> The centrality of work in the day-to-day lives of people and the ways in which work influences the social, civic, cultural, and personal relationships of individual must take on new meanings and a new emphasis in the total educational process. An occupation is the most occupying of all human activities. It sets the standard of living, it influences family relationships, and it controls the quantity and quality of civic participation and responsibility. Education looms large as a factor in the solution of the social upheavals of the 1960's, and the ability to perform the work that society is willing to buy is one of the elements, related to the social problem.[1]

Thus, as the need for more and better education has increased

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[1] Advisory Council on Vocational Education, Notes and Working Papers Concerning the Administration of Programs Authorized Under Vocational Education Act of 1963 - Public Law 88-210 as Amended (Washington, D.C.: United States Government Printing Office, 1968), p. 73.

at a rapid rate, it has become essential to search for new and more effective means for education to meet the demand. Vocational-technical education has taken on new dimensions as the labor demands change to require higher levels of preparation for employees, coupled with diminishing opportunities for the less prepared. There is also recognition that many young people leave school without the necessary preparation to enter the world of work.

> The concept of an area vocational school which would serve more than one school district, would respond more rapidly to the demands of the labor market, and would experiment more aggressively with new programs had gained the enthusiastic endorsement of the more progressive vocational educators prior to the passage of the Vocational Act of 1963. The National Defense Education Act endorsed the concept but limited its support to the training of technicians. The Vocational Act of 1963 expanded the use of Federal funds for the construction of area vocational schools to include training for any non-professional occupation.[1]

The secondary area vocational-technical school concept as developed in Pennsylvania has made a wide variety of occupational training opportunities available to many high school students throughout the state. An area vocational-technical school is organized in a fairly large area, often a county. From the surrounding academic high schools, on a full-time, half-day, or week-about basis of instruction, it draws those students who are interested in specialized shop and laboratory instruction such as: auto mechanics, machine shop, agriculture, practical nursing, computer programming, distributive education, electronics, beauty culture, secretarial service, and so on.

Kaufman and Lewis view the extensive growth of vocational-technical

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[1]Advisory Council on Vocational Education, Notes and Working Papers Concerning the Administration of Programs Authorized Under Vocational Education Act of 1963 - Public Law 88-210 as Amended (Washington, D.C.: United States Government Printing Office, 1968), p. 22.

education in Pennsylvania as the result of the convergence of two main trends.

> The first is the rising national awareness that the majority of our young people were being poorly prepared by our schools to assume a productive place in the labor force. On the average, only about three-fourths of the students in a ninth grade class graduate from high school and only about one-half of these graduates, roughly one-third of the ninth grade enrollment, enter college. Despite this the main emphasis in high school instruction has been directed to those students who plan to go on to college. The second trend, which has influenced Pennsylvania more specifically, was the long-view economic decline in the state. The high rates of unemployment, the slow growth of population, and the actual drop in population in the 15 to 30 age group prior to 1963, alerted educators and legislators that corrective action was necessary.[1]

The area vocational-technical school exists to make the community educational offerings more comprehensive for students who have the interest and the ability to pursue education in preparation for gainful employment. Thus, the majority of students who will not complete a baccalaureate degree can still matriculate into the mainstream of society and become productive citizens. More specifically this administrative organization (area vocational-technical school) was developed to achieve two purposes: (a) to maintain a large enough enrollment to justify a diversified curriculum which would offer training for many employment opportunities and (b) to provide a choice of vocational training to persons of a large area of residence.[2]

The Vocational Education Act of 1963 and subsequent amendments

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[1] Jacob Kaufman and Morgan Lewis, The Issues Evaluation, and Potential of Vocational Education in Pennsylvania (University Park, Pennsylvania: The Institute for Research on Human Resources, 1967), p. 1.

[2] Chester Swanson, "Vocational Education Beyond the High School", Vocational Education, in the Sixty-Fourth Yearbook of The National Society for the Study of Education (Chicago, Illinois: University of Chicago Press, 1965), p. 174.

have given great financial impetus to the development of vocational-technical education nationally.

Vocational-technical education is becoming an increasingly larger part of public secondary education in Pennsylvania. The construction and operation of both full-time and part-time secondary area vocational-technical schools has been remarkable since the approval of the first vocational-technical education attendance areas in the mid-1950's. Numerous school boards have authorized its officers to sign articles of agreement to establish and operate an area vocational-technical school in cooperation with other school districts.[1]

The Pennsylvania State Board of Education has urged the continued expansion of secondary vocational education programs throughout the state so that by the end of the 70's every secondary high school student will have a marketable skill upon completion of high school. The goals for vocational-technical education point the way to the development of vocational-technical education opportunities for persons of all ages in all communities of the state. Included in the recommendations the State Board of Education has made is the expansion of the area vocational-technical school (AVTS) concept.

> Utilize innovative types of programs and methods of teaching such as educational closed circuit television, mobile shop units, self-instructional programmed learning packages and audio-visual devices to increase the number of students who can be reached with vocational subjects, particularly in sparsely populated areas where vocational education programs are practically non-existent.
>
> In populous areas build additional area vocational-technical schools and continue to add vocational subject coverage in comprehensive high schools which are not close enough to an AVTS for a time sharing arrangement.

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[1]Walter Arnold, An Evaluation of Vocational-Technical Education in Pennsylvania in 1970 (Washington, D.C.: American Vocational Research Corporation, 1970), p. 3.

Through in-service training obtain the assistance of guidance personnel and teachers in all high schools in conveying the need for preparation for the "World of Work" to all students, not only those who are vocationally program minded. College bound students should have at least one saleable skill in addition to the qualifications for college entrance.[1]

B. Purpose Of The Study

It is evident that AVTS enrollments are increasing in Pennsylvania. The data reported in Table 1 reveal that more than $250 million has been invested for construction of seventy-five AVTS over the period 1964 to 1973.[2]

TABLE 1

AVTS CONSTRUCTION AND FUNDING

Pupil Capacity	Equipment Cost	Total Cost of Project	Vocational Ed. Act of 1963 & 1968	Appalachia Regional Dev. Act
55,220	$51,554,994	$263,790,801	$35,432,593	$17,620,892

This type of economic investment and the national emphasis on manpower training point the way to the AVTS becoming an extension of the educational program of the community.

The purpose of this study was to determine if differences exist in part-time AVTS and full-time AVTS with regard to academic programs, student achievement, and student opinion.

The conclusions and findings of this study should be of interest

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[1]Walter Arnold, An Evaluation of Vocational-Technical Education in Pennsylvania in 1971 (Washington, D.C.: American Vocational Research Corporation, 1971), p. 10.

[2]See Appendix A

to the Pennsylvania State Bureau of Vocational, Technical and Continuing Education in providing information and guidelines. Educators, parents and others concerned with providing educational opportunities for students may also find the findings of this study of interest.

C. Review Of Related Literature

We live in a world of rapidly changing technology. If anything, the future promises even more rapid change. One reaction to this state of affairs has been an insistence on advantages of a general as opposed to a vocational education. This viewpoint maintains that a general education provides multi-directional base for whole families of occupations whereas vocational education ties individuals to occupational skills that are likely to become obsolescent. The opposing viewpoint maintains that what is needed is more, not less, vocational education at the high school level. It is pointed out that the majority of those who complete a general education still do not go to college. And, of those that do a substantial percentage do not complete their college education. The end result, it is claimed, is that hundreds of thousands graduate from high schools ill-equipped to face the problem of finding jobs. Vocational education would be realistic.[1]

The history of education shows an uneasy relationship between general and vocational education. Early apprenticeship agreements in this country required the master to teach not only a useful employment, but also fundamental literacy and civic and moral responsibilities. But many masters were unable to provide adequate non-vocational instruction,

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[1]Max Eninger, The Process and Product of T and I High School Level Vocational Education in the United States (Pittsburgh, Pennsylvania: American Institute for Research, 1965), p. 3.

and during the eighteenth century began to send their apprentices to evening schools for the three R's. This is the first example in this country of the separation of vocational and academic instruction.

The decline of apprenticeship in the early nineteenth century stopped vocational instruction for most American youth. Formal schools confined their occupational instruction to the professions, and generally were available only to children of the wealthy. The idea of combining vocational and general education grew gradually through lyceums and mechanics institutes until it culminated in the land-grant colleges.

Economic considerations as well as the opposition of academicians made the extension of vocational education into the common schools a far more difficult matter. But during the last half of the nineteenth century a method which appeared to provide a practical solution came from Russia. Della Vos, an engineer, had developed a system of instruction shops where students were taught to use common tools as they completed a graded series of exercises. Although this system was adopted first at the college level, it quickly became the basis for the manual training program in the secondary school. This appeared to bring vocational and general education, at this level, together again. But manual training did not really meet vocational training needs. Thus, the cry for realistic vocational education appeared, and resulted in state and federal legislation supporting more specific instruction in a limited number of occupational fields. The first step of the new vocational educators was to set up separate vocational schools. This not only had the unfortunate effect of separating general and vocational education, but it clearly was an attack upon the educational irrelevance of the literary instruction which was labeled general education. The response of leading American educators

was the creation of the comprehensive high school, which was designed to serve all youth.[1]

The comprehensive high school has met many challenges over the years with a varying degree of success. Evans expresses the view that the basic difficulty is in implementing the concept of the comprehensive school.

> Too often, a school which bears this name tries to meet the needs of all students simply by putting programs for all students under the same roof. What we need is a community high school and a real community (junior) college which is not content to have competing programs under the same roof but fuses academic and vocational education as everyday partners. One of the first ways to make vocational and general education everyday partners is to establish instructional programs which point out to students that instruction in every class is relevant to what they are now learning, and will be relevant in their lives ahead.[2]

Wells has suggested a new regard for vocational education is emerging.

> College preparatory education is as much a part of the high school scene as PTA's and football. Pre-academic training goes back to 1647 when Massachusetts Bay Colony law required towns of 150 households to establish a grammar school where youths could be "fitted for the university". This law laid the foundation for and shaped the curricula of our present schools. Publicly supported vocational education was not seriously undertaken until 1917 with the passage of the Smith-Hughes Act, although a few technical-vocational schools had existed at the turn of the century.
>
> From the beginning, vocational training and guidance has had to struggle to maintain its niche in the secondary school. Vocational educators have fought an unfavorable image, union rejection, industrial pressures, biased credentialing standards, apprenticeship and money problems, and just plain apathy throughout their history.

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[1]Vincent P. Lannie, "The Development of Vocational Education in America: A Historical Overview". in Vocational Education, a Prospectus for Change, edited by Carl Schaefer and Jacob J. Kaufman (Boston: Massachusetts Advisory Council on Education, 1967), p. 63.

[2]Rupert N. Evans, Foundations of Vocational Education (Columbus, Ohio: Charles E. Merril Publishing Company, 1971), p. 58.

> Today, thanks to the problems occurring in many inner-city schools and the difficulty of placing college graduates, we may be in the midst of a vocational education revolution. The helmsmen of business and industry are calling for high school graduates with saleable skills. Educators are talking about "career education". Federal funding, that weathervane of our interests, is now shifting toward the vocational scene. It could be that we are on the verge of a meaningful transformation in modern secondary education.[1]

Vocational education is not a threat to academic education. Vocational education will continue to complement the academic preparatory curriculum in the high school. Certainly the skills necessary to run a drill press do not constitute a complete education. The acquisition of knowledge is the first step toward attitude development and an appreciation of life. As vocational education becomes more popular, the mutual relationship of pre-academic and skills courses will be recognized.[2]

Schaefer and Kaufman see vocational education making a unique contribution.

> The youngster who is essentially non-verbal can be shown the utility of reading when reading skills make it easier for him to follow the instructions for a machine he wants to use. He can be shown how a knowledge of certain scientific laws makes it easier for him to solve the particular problems he encounters. He can be shown how to represent some problems in algebraic or geometric terms and he can see the advantages of manipulating them in this style rather than physically. All of these learning experiences can be shown to be immediately relevant to problems he is trying to solve. There is a much higher probability that concepts learned in this manner will be retained and applied in similar situations in the future.
>
> Along with an increase in the relevance of the materials studied, the style of vocational education has several additional advantages. It is project-oriented and the student can experience a sense of accomplishment, which producing useful object yields. Such a sense of accomplishment this type of student rarely or never experiences in the academic classroom. The instructional process of an occupational-oriented type by its very nature tends to be individualized. The instructor works with the

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[1] Carl E. Wells, "Will Vocational Education Survive?" Phi Delta Kappa, LIV (February 1973), p. 369.

[2] Ibid., p. 380.

> students individually as they progress at different speeds on different projects. The mood in a vocational shop is informal and relaxed. Rather than requiring the students to sit quietly, they can move about to obtain needed materials or tools. As a final bonus, the instructor, by observing the student's work, can set standards for disciplined work habits and personal responsibility.[1]

A well-planned vocational program integrates vocational education and academic education. Evans suggests vocational development be built on a sound base of general academic education.

> Vocational education provides a reason for learning basic academic skills. It lets the student know that these skills are important in life, and more particularly, are important in achieving his occupational goals. Too often, however, the knowledge of the importance of basic academic skills comes late in a student's school life. Most vocational education begins at age sixteen, and many schools do not offer remedial instruction in basic academic skills to students of this age. Many vocational teachers proceed to do the best they can, and teach basic academic skills in the vocational classroom. This is of some help, but most vocational teachers are not well prepared for this type of instruction. If the student could have learned earlier that basic academic skills are important, or if remedial classes could be offered concurrently with vocational education, more effective results could be achieved.[2]

The following position statement of the Pennsylvania Department of Vocational, Technical, and Continuing Education stresses the nature of the relationship between vocational-technical education and academic education.

> Vocational-technical programs do not take the place of general academic education, but rather supplement and enhance it for students who want and need training for a chosen occupation. Vocational education is an important part of a well-balanced program of studies--not a single subject--which is aimed at developing competent workers and recognizes that the American worker should also be competent economically, socially,

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[1]Carl J. Schaefer and Jacob J. Kaufman, New Directions for Vocational Education (Massachusetts: Heath Lexington Books, 1971), p. 14.

[2]Rupert N. Evans, Foundations of Vocational Education (Columbus, Ohio: Charles E. Merrill Publishing Company, 1971), p. 56.

> emotionally, physically, intellectually, and in a civic sense. Effective vocational education is more inclusive than simply training for job skills. It also develops abilities, understandings, attitudes, work habits, and appreciation which contribute to a satisfying and productive life.[1]

Vocational education must be representative of a system which will allow every individual to develop an interest in a vocation, develop job skills, participate in work experience, identify with the dignity of occupational choice, and evaluate the relevance of the total educational process. Thus, Michie's view is to say that vocational education should become the core of the modern curriculum and that the remainder of the curriculum should become more fully and concisely related to the core. Furthermore, if we wish to make schools meaningful to young people--to give them a future better than their past--we should reconstitute our total education system so that vocational education becomes education.[2]

The National Advisory Council on Vocational Education has reported that vocational education is still not reaching the vast numbers of students who could and should benefit from it. There is a need to expand the options of the vast majority of students who will not complete a college program, the need to offer students more relevant, educational experiences, and the need to offer the skill training needed for the world of work in the latter part of this century. Without domineering, vocational education must assume a leadership role to help impart to the total educational system the discipline and approaches which are unique to vocational education. And most importantly, vocational education must continue

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[1]Walter Arnold, Vocational, Technical, and Continuing Education in Pennsylvania--A Systems Approach to State-Local Program Planning (Harrisburg, Pennsylvania: Department of Public Instruction, 1969), p. 470.

[2]Jack Michie, "Designing a New Image for Vocational Education". School Shop, XXXI (October 1971), p. 44.

to modernize its own curriculum and techniques in order to fulfill the demand for skill training in the new and emerging occupations. If greater numbers of our high school students are to leave school with a marketable skill, vast expansion of the vocational education component will be required.[1]

Weber has directed vocational educators to evaluate their role in education and manpower training in terms of contemporary circumstances.

> First, it's important for vocational educators to recognize that vocational education exists in a pluralistic society, in a pluralistic labor market. The acquisition of skills in any modern industrial society was never the exclusive province of one particular form of pedagogy. There is formal vocational education, there are apprenticeship programs, there are on-the-job training programs, and there are coupled programs, and there are many brilliant permutations.
>
> My point is, you have to recognize that it's a great big wonderful labor market and the process of skill acquisition takes place in many forms and under many institutional arrangements so that you can't exert an exclusive claim to everything that has the label 'training' or 'education' on it. In fact, what you have to do is to better identify your comparative advantage and how you can make your contributions to other modes of training which fall out the formal educational system.
>
> Secondly, I think that vocational educators, as well as friends in the Employment Service, will have to share the action in this area with other institutions. Vocational education in this country is no longer merely a matter of education ala Smith-Hughes. It's big social policy and big educational policy and big economic policy.[2]

The United States Office of Education has outlined the area of federal responsibility for support of vocational-technical education based on two fundamental beliefs: first, that vocational-technical education is essential to the welfare of the nation; second, that federal funds

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[1] Lawerence Davenport, "We Still Need Vocational Education". School Shop, XXXII (April 1973), p. 66.

[2] Arnold Weber, "Vocational Education in a Pluralistic Society", American Vocational Journal, XLVI (February 1971), p. 29.

are necessary to stimulate and assist states in making adequate provisions for vocational-technical training.[1]

Sociologist Kievit sees vocational education as a possible solution to overcome urban problems such as: high welfare costs, blighted structures, congestion, and overloads on community services. Thus, the population flow of unskilled, poorly educated rural dwellers into the city ghettos for jobs that are no longer there has important social significance for vocational education as it impinges on: the knowledge, skill, and competencies to be developed in vocational areas; the educational setting and structure of the learning and teaching processes, and the student's need for non-vocational cognitive and affective outcome, to which vocational education can contribute.[2]

Venn raised basic questions regarding vocational education in the public schools in reporting a study conducted for the American Council of Education. Included among his recommendations was the following:

> Occupational education must be an integral part of total education and a responsibility of every segment of the total educational system.[3]

The Essex report develops at length the proposition that there is no longer any room for a dichotomy between intellectual competence and manipulative skills and, therefore, between academic and vocational education.

Vocational education is not a separate discipline within

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[1]Lloyd D. Briggs, "Support from the Top", American Vocational Journal, XLVI (November 1971), p. 43.

[2]Mary Kievit, "Social Issues Confronting Vocational Education", American Vocational Journal XLVI (December 1971), p. 15.

[3]Grant Venn, Man, Education, and Work (Washington, D.C.: American Council on Education, 1967), p. 184.

education, but it is a basic objective of all education and must be a basic element of each person's education. It is also a teaching technique which may have even more to offer as method than as substance. As a selecting out process for the professions, education has fostered, stressed, and rewarded the verbal skills important to these pursuits. It has given too little attention to development of attitudes, manipulative skills, and adaptability to new situations. In the process of emphasizing verbal skills, the predominant methods of instruction are lecture and discussion, and little attention is given to the alternative technique of learning by doing. For many students, the techniques of vocational education can supply a core around which an attractive package of academic as well as skill content can be prepared which will be more palatable and useful to undermotivated students than either alone. This may be most applicable to those from deprived environments whose verbal experiences have been limited and whose time horizons have been shortened by expectation of failure. Skill development can be accomplished through work experience or through education in the school's shops and laboratories. The key is to build a better means of integrating academic education, skill training, and work experience. The common objective should be a successful life in which employment has a crucial role.

It is no longer possible to compartmentalize education, and vocational components. Education is a crucial element in preparation for a successful working career at any level. With rising average educational attainment, better educated people are available so that the employer seldom needs to accept the less educated. If it represents nothing else, a high school diploma is evidence of consistency, persistence, some degree of self-discipline, and perhaps even of docility. The relevance of education for employment arises from better educated labor and a technology that requires it. The educational skills of spoken and written communication, computation, analytical techniques, knowledge of society and one's role in it, and skill in human relations are as vital as the skills of particular occupations.

On the other hand, employability skills are equally essential to education. If education is preparation for life, and if practically everyone's life and opportunities for self-expression and self-fulfillment include work, then only the successfully employable are successfully educated. American society is achievement oriented and attributes something less than wholeness to the non-striver and non-achiever. Culture and vocation are inseparable and unseverable aspects of humanity.[1]

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[1] Advisory Council on Vocational Education, Notes and Working Papers Concerning the Administration of Programs Authorized Under Vocational Education Act of 1963 - Public Law 88-210 as Amended (Washington, D.C.: United States Government Printing Office, 1968), p. 73.

Prakken did an analysis of future trends in vocational-technical education and briefly reported areas of growth.

> Recent crystal-ball gazing by the Division of Vocational and Technical Education and the National Center for Educational Statistics of the U. S. Office of Education indicates a tremendous growth in enrollment in vocational programs at the secondary level by 1976. In four years, 41.1 percent of students will be in vocational programs, compared with 24.3 percent in 1971. This is an increase of nearly two million students.
>
> Trade and industrial education areas that are going to have the greatest numerical growth include aviation, blueprint reading, electrical, electronics, graphic arts, and metal-working occupations. Minimal growth is forecast for most of the construction and woodworking trades, with about a 10 percent decline in drafting occupations.
>
> Among the technologies expected to increase substantially are architectural, automotive, and electronics.[1]

Lerwick indicates that a self-examination of vocational-technical education has resulted in the possibility of several alternatives.

> Until recently the role of secondary education was clearly understood. It was the primary screening device for admission to higher education. Further screening by college registrars and undergraduate attrition determined who would enjoy the benefits of a baccalaureate degree. Those benefits were understood and unquestioned. The fate of students who did not follow the classic sequence was left to the discretion of society.
>
> Practical arts were the "poor relatives" of more exotic programs. The specialized field of vocational education struggled with the question of occupational placement. Within the narrow specialty there existed some philosophic dispute over the nature and purpose of learning. These arguments helped relieve the boredom of colorless curriculums and resulted in some utilitarian solutions to non-college placement.
>
> Few in vocational education expected to be anything but an insignificant minority in the larger sphere of education. Certainly no one expected to influence higher education beyond the "privilege" of preparing leaders for the field. But with the advent of career education and the trend toward the economic model, a role reversal has been experienced. Vocational educators suddenly find themselves riding the crest of a rise to power and influence.

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[1] Lawrence W. Prakken, "Crystal Ball Gazing". School Shop, XXXII (January 1973), p. 1.

> Two factors seem to explain vocational education's encroachment on the sphere of higher education. First, there is the "education inflation" as expressed by a massive rise in post-secondary educational alternatives. A struggling vocational program or adult education class conducted in a high school basement or abandoned warehouse is a laughable imitation of a prestige campus. The erection of a ten million dollar post-secondary facility is quite another matter.
>
> Secondly, there is the increased sophistication of occupational job requirements. The usual high school preparation fails to meet the requirements of an increasing number of job descriptions.
>
> Some educators would argue that these factors are artifically created. That they appear real is the only issue relevant to the discussion here. Mass enrollment in alternative education is witnessed by statistics that promote an awed public acceptance.
>
> Under the existing circumstances, vocational education can expect to have considerable influence throughout education. The field can look forward to having a voice in the evaluation of instructional relevance.[1]

Feldman sees vocational education on the edge of a new era. Pointing to the fact that in 1973 more than half the American work force were employed in jobs for which educators prepared them, he suggests that until now the majority of America's workers have been trained on the job.

> The message is clear. If education is to regain the confidence of the people, it must produce results that make sense to people.
>
> I believe that the public wants two things--one very consciously, the other more subconsciously.
>
> The public's conscious demand is that education be made relevant to the world of work. What vocational educators have known for years--that America is miseducating at least half its young people--has, at last, become an article of the conventional wisdom.
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> On this count alone, vocational educators are in a stronger position than we have ever been before. Our intention has been from the beginning to prepare people realistically for

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[1] Lowell Phillip Lerwick, "Whither Vocational Education: Left or Right?" American Vocational Journal, Volume 49, Number 4 (April 1974), p. 28.

> the world of work. And, I believe, we are delivering that intention with increasing skill and accuracy.
>
> But the public's subconscious demand is another matter altogether. It is a demand that education be made more relevant to the achievement of the good life.
>
> An elemental new reality is being thrust upon American educators. Masses of people are beginning to see life's larger possibilities and a need to pursue them.[1]

McMahon presents a case for a broader participation and greater involvement in the total educational enterprize to bring the school and community to a better understanding of the needs of youth.

> The school as an institution has been the subject of major controversy for as long as it has existed as an organized segment of society. Should its teachings mirror the image of society? Should it lead, follow or restrain the activities of the community? Should it serve an elite that would preserve learnings in its purest form or reach out to serve everyone? Should it carry on its activities in an ivory tower or come face to face with the reality of life? Consideration of the present state of public education suggests that there have been no permanent solutions to these questions; nor is there any evidence that such solutions are in prospect for the immediate future.
>
> Certainly, it is necessary in our complex world to transmit and enlarge the understanding of the sciences, to preserve the purity of the language, to maintain the continuity of historical research. But these pursuits quite properly affect only a tiny minority of the work force.
>
> The great majority must be concerned with the realities of life--with creating, operating and repairing the mechanical marvels of our industrial society; with producing, processing and distributing our food supplies; with preserving and improving the health of the community; with supplying the instruments and the facilities for our leisure-time activities. These are the realities for most of us and education can be a powerful force in promoting the smooth transition of youth from the status of student to that of productive worker in the real life of our complex economic structure.
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> We are painfully aware that many influential voices are still

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[1] Marvin J. Feldman, "The Place of Technical Education in the Total Educational System". Man, Society, Technology, XXXIII, (May, June, 1974), p. 229.

heard proclaiming the sanctity of education as a world apart from reality and deploring any efforts to bring the school and community into a genuine partnership. However, there are many encouraging signs that business, industry and agriculture are ready and willing to join with the schools in well-conceived and well-planned cooperative projects.[1]

D. Historical Development Of AVTS

Throughout the years, the Smith-Hughes Act, the George-Bordon Act, the Vocational Education Act of 1963, and the Vocational Education Amendments of 1968 have given great financial thrust to the development of vocational-technical education. Federal funds have been made available to the states for vocational education by the United States Congress every year since 1917.

In Pennsylvania the impact of the various funding resulted in a substantial construction effort and the extensive development of the AVTS concept. During the period 1964-1973, seventy-five AVTS were constructed in Pennsylvania to serve 55,220 secondary students at a cost of $263,790,801.[2]

E. Review Of Related Research

Gaenge conducted a study to examine attitudes toward vocational education in the Princeton School District to determine if there were any differences that should be given administrative consideration. He formed the following conclusions:

1. All eight communities were supportative of vocational education.

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[1] Gordon G. McMahon, "Education for The Realities of Life". American Vocational Journal, Volume 48, Number 8 (November 1973), p. 25.

[2] See Appendix A

2. Parents supported the joining of school districts to form a joint school district.

3. Finally, when asked specifically if they would allow their own child to attend if he or she wished to go, parents supported vocational school attendance. However, support was higher when asked about allowing students in general to attend. Not only was the vocational program seen as helpful to the individual involved, but was recognized as beneficial to the community as well.[1]

Many research studies have been conducted to determine cost analyses of vocational education. Yackee attempted to determine if an investment in vocational education receives a higher social rate of return than an investment in a general high school education in a rural, Appalachian Ohio area.

> When the type of student who graduated from a vocational education program was compared to the type of student who graduated from a general high school program, little difference was found in ability, socio-economic standing, or beginning wage rates. According to this study the program from which the student graduates does not have a significant effect on wages and earnings during his first year after graduation. The data does indicate that whatever causes one to do better than others in class work (other than sex) also helps determine how his earnings will compare to others when he enters the labor market. The data also indicated that class work becomes important after the graduate's initial entry into the labor market, with significant effect on wages and earnings after the first job.[2]

Yackee leaves the question of cost benefit to be answered by

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[1]Donald E. Gaenge, "Study of Parent Attitudes Toward Vocational Education: A Sociological Analysis" (Unpublished Ph. D. dissertation, Miami University, 1973).

[2]Keith Warren Yackee, "The Social Rate of Return on Investment in Vocational Education: A Case Study in a Rural Appalachian Ohio Community" (Unpublished Ph. D dissertation, Ohio University, 1973).

others; however, he believes that vocational education programs can have positive influences on student self-concept and level of personal satisfaction of graduates who rebel against or feel lost in more traditionally academic programs.

In a study of the effectiveness of area vocational school programs as they relate to self-perceived interests and needs of students, Wong investigated area vocational schools in Texas.

> Students who participate in the AVS program report that the vocational training which they receive is highly effective in meeting their self-perceived interests and needs. Non-participators involved in educational programs other than the AVS report medium effectiveness of these programs in meeting their individual interests and needs. In addition, non-participators perceived the AVS program as less effective in meeting student interests and needs than did those who were enrolled in the program. Findings also give indication that although perceptions of vocational education programs have improved in very recent years, their image still reflects unfavorably biased attitudes.[1]

In a study of organization and practices in fifteen vocational-technical schools in the United States, Dennard concluded: vocational-technical education curricula are offered in a variety of educational institutions having dissimilar organizational patterns; secondly, the majority of the vocational-technical schools developed their organizational patterns to the prevailing administrative structure of the local school system as it related to length of term, length of instructional periods, and grade reporting.[2]

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[1]LaVerne Wong, "Student Perception of the Effectiveness of the Area Vocational Secondary School Programs of Texas in Meeting Self-Perceived Interests and Needs". (Unpublished Ph. D. dissertation, Texas A & M University, 1973).

[2]Cleveland Dennard, "The Administrative Organization and Practices of Selected Vocational-Technical Schools in the United States with Implications for the Atlanta Vocational-Technical School". (Unpublished Ed. D. dissertation, University of Tennessee, 1964).

Massachusetts the unique relationship of the vocational-technical program and the academic program is presented in a recommendation.

> It is recommended that high school students at the Institute belong to their respective secondary high schools for purposes of graduation, athletics, extra-curricular activities, and state required subjects.
>
> This recommendation imposes upon public education in the Commonwealth an adequate network of Institutes and provides for their maximum utilization in terms of scheduling high school students. Such a network obviously will need to be established within easy transportation range (within approximately 30 miles).
>
> The fundamental principle that students would belong to their local high schools denotes a scheduling system which will eliminate the one or two week "about" plan now frequently required by most vocational schools. There is little evidence that this plan is advantageous to either the instructional process or the student. In fact, the evidence is to the contrary, as revealed in several studies conducted by the State of Ohio. It may be argued that correlation of instruction in the mathematical, scientific, and communicative skills with the shop or laboratory instruction can only be fully achieved through an arrangement which relates all of the instruction on a daily basis.[1]

Students enrolled in the coordinated vocational-academic education experimental program in Texas find a flexible academic curricula which is functional and has practical application to their occupational training.[2]

In another experimental program recent developments in social studies and their possible relationship to vocational education were studied. Team effort seems to be indicated because of the need for instructional materials and approaches which combine the competencies,

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[1]Carl J. Schaefer and Jacob J. Kaufman, New Directions for Vocational Education (Massachusetts: Heath Lexington Books, 1971), p. 207.

[2]Edward Darnall, Coordinated Vocational-Academic Education (Edinburg, Texas: ERIC Document Reproduction Service, ED 289, 1972), p. 7.

insights, and sensitivities of social science and vocational-technical people.[1]

Dittenhafer suggests that academic behavior of students may be affected by the degree of program separation. He speculates that the vocational-technical students in the complete separation schools (full-time AVTS) will exhibit lower academic achievement than their counterparts in the partial separation schools (part-time AVTS).[2]

Vocational-technical education is offered in various organizational patterns. In addition to the various organizational plans there are several methods used for scheduling students for vocational-technical instruction. Such scheduling may include half-day about, day about, week about, two week about, three week about, or any other schedule which meets the state requirements. Benson suggests research might show which organizational plan is most effective as well as which time schedule might have the most positive effect on students.[3]

Norris studies how students enrolled in the Southern Oklahoma Area Vocational-Technical Center were affected in their behavior at the home high schools. It was found that students who did not attend the vocational-technical center did earn significantly higher grades in academic courses at their home high schools than were earned by those students who

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[1]Dwight Allen, Flexibility for Vocational Education Through Computer Scheduling (Washington, D.C.: ERIC Document Reproduction Service, ED 021 972, 1967), p. 22.

[2]Clarence Dittenhafer, "Students' Perceptions of Personality Needs and Environmental Press as a Function of Program Separation" (Unpublished Ph. D. dissertation, Rutgers University, 1972), p. 36.

[3]Ralph Benson, "A Study of the Self-Concept of Sophomores Enrolled in a Part-Time AVTS in It's First Year of Operation" (Unpublished Ph. D. dissertation, University of Pittsburgh, 1973), p. 75.

attended, on a half-day basis, the Southern Oklahoma AVT Center.[1]

In an investigation of the area vocational school of the Appalachian region, Sanders and Dennis reported evidence of efforts being made to relate vocational and academic education.

> Much is done to promote articulation between vocational education teachers and their academic colleagues. All of the schools visited attempted in varying degrees to enable academic instructors within the school system to better understand vocational education. Through meetings, field trips, and joint committee action, many academic teachers are beginning to realize the advantages of vocational education. Greater understanding and cooperation seems to occur in comprehensive high schools where academic and vocational teachers have greater contact with one another. One comprehensive school was so designed that traffic patterns and class schedules necessitated all students to frequent parts of the plant that housed both vocational education and academic activities. More effort is required when separate campuses are involved. However, administrators, counselors, and teachers are making concerted efforts toward bridging the gap between vocational and academic educators in these situations.[2]

Kaufman and Lewis conducted an investigation of vocational-technical education in three selected cities in Pennsylvania and reported several interesting findings. Of importance to this study is the following:

> Although the current emphasis on area vocational-technical schools would appear to be misdirected, the Commonwealth is apparently committed to their development. In light of this commitment, policies should be established that attempt to make the students who attend these schools feel fully accepted in their home schools and greater efforts should be made toward the development of new, broader programs in which the vocational programs are carefully coordinated with the

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[1]Norris Marsena, "Selected Behavioral Changes of Students Attending the Southern Oklahoma AVT Center" (Unpublished Ed. D. dissertation, Oklahoma State University, 1968).

[2]George Sanders and William Dennis, The Impact of the New Area Vocational Schools on the Appalachian Region (Washington, D.C.: ERIC Document Reproduction Service. ED 056 431, 1971), p. 7.

academic programs of the sending school.[1]

F. Summary

Vocational education and academic education are two necessary aspects of every person's education. Everyone must be prepared for modern living, both academically and vocationally, and it is of little value to sharply define the territory of either phase of education. There is no justification for conflict between the two. For many students vocational-technical education can make the academic program important and valuable. A goal of both vocational and academic education is to assist young people to become successful in their occupations, to earn a comfortable living, to enjoy self-esteem, and to take a continuing interest in learning.

For the sake of the majority of our young people seeking to find their place and to gain their rightful share of our national wealth and production we should encourage real cooperation among the educational agencies concerned with all public education. The entire program of rightly relating the two necessary aspects of preparation for the world of work in a scheme of education depends for a solution upon a sympathetic understanding, by representatives of each phase of the problem, of the character and function of the other; and upon a broad comprehension by both of the whole problem of education.

The available research does not resolve or adequately address the question of academic achievement and school setting. Some studies have

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[1] Jacob Kaufman and Morgan Lewis, The Issues, Evaluation, and Potential of Vocational Education in Pennsylvania (University Park, Pennsylvania: The Institute for Research on Human Resources, 1967), p. 158.

recognized the problem but none, to this researcher's knowledge, have attempted to provide information concerning the level of academic achievement and the part-time or full-time area vocational-technical high school.

CHAPTER II

THE PROBLEM

A. Statement Of The Problem

How does the academic achievement of students in a full-time comprehensive area vocational-technical high school compare to the academic achievement of students who attend a part-time area vocational-technical school?

B. Additional Questions

This research will, in addition to the study of achievement, provide information for the following questions:

1. How do full-time comprehensive area vocational-technical schools compare to part-time area vocational-technical schools with regard to: general academic curriculum, supportive academic course offerings and flexibility of student scheduling?

2. What are the opinions of students in a full-time area vocational-technical school regarding their academic program and achievement?

3. What are the opinions of students in a part-time area vocational-technical school regarding their academic program and achievement?

C. Hypotheses

1. (H_i): There will be no differences between academic programs

of full-time area vocational-technical schools and part-time area vocational-technical schools with regard to:

a. general academic curriculum

b. supportive academic course offerings

c. graduation requirements

d. flexibility of student scheduling

2. (H_o): There will be no significant differences in the verbal ability and mathematics achievement of students in full-time area vocational-technical schools and part-time area vocational-technical schools.

3. (H_o): There will be no significant differences in the verbal ability and mathematics achievement of students in large AVTS (part-time and full-time) and small AVTS (part-time and full-time).

4. (H_i): There will be no differences between student opinions of academic programs and achievement in full-time AVTS and part-time AVTS.

D. Delimitations

1. This study will be delimited to seniors of the 1973-74 school year in the full-time and part-time area vocational-technical schools.

2. This study will be delimited to senior students in the trade and industrial programs.

3. This study will be delimited to an analysis of academic achievement as measured by the Series II of the School and College Ability Test (SCAT Series II).

4. This study will be delimited to an analysis of student opinion as measured by the semantic differential questionnaire.

E. Definition Of Terms

1. Area Vocational-Technical School (AVTS) -- The vocational

service center which provides the shop/laboratory instruction for the students in the attendance area. Students may or may not receive instruction in academic subjects.

2. Full-time comprehensive AVTS -- The vocational service center in which the students receive the shop/laboratory instruction and the required academic subjects.

3. Part-time AVTS -- The vocational service center in which the students only receive the shop/laboratory instruction. The students return to the sending high school for the required academic subjects.

4. Academic program -- The instruction in selected cognitive areas such as mathematics, science, English and social studies.

5. Vocational-technical program -- The scheduled pattern of courses designed to prepare a student for employment at the completion of the program.

6. Achievement -- The measure of attainment of students as determined by the Stanford Achievement Test, High School Battery.

7. General academic curriculum -- The program of academic courses which are available to students. This program would include all academic offerings which students could elect to take during their high school experience.

8. Supportive academic course offerings -- The academic courses which are closely related to shop and laboratory work. The aim of these courses is to specifically assist the student in better understanding some of the experiences in the shop and laboratory instruction.

9. Large AVTS -- A vocational service center (part-time or full-time) which provides shop/laboratory instruction for a large enrollment. The sample school student enrollments were nearly 1,500.

10. Small AVTS -- A vocational service center (part-time or full-time) which provides shop/laboratory instruction for a small enrollment. The sample school enrollments were nearly 500.

CHAPTER III

RESEARCH DESIGN

A. General Method

The research process utilized in this study was the descriptive method. John W. Best defines the descriptive method of research as:

> Research concerned with conditions or relationships that exist; practices that prevail; beliefs, points of view, or attitudes that are held; processes that are going on; descriptions and interpretations of what is; effects that are being felt; or trends that are developing.[1]

B. Specific Technique

1. The Series II of the School and College Ability Test (SCAT Series II) was administered by this researcher in the following areas:

Test	Working Time in Minutes	Number of Items
Verbal ability	20	50
Mathematical ability	20	50

The verbal score is based upon the number of correct responses to 50 verbal analogy items in 20 minutes. Each question begins with two words. These two words go together in a certain way. Under them, there are four other pairs of words lettered A, B, C, and D. The student is to

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[1] John W. Best, Research in Education (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1959), p. 102.

identify the lettered pair of words that go together in the same way as the first pair of words.

The mathematical score is based upon the number of correct responses to 50 quantitative comparison items in 20 minutes. Each of the questions has two parts. One part is in Column A. The other part is in Column B. The student must determine if one part is greater than the other, or if the parts are equal, or if not enough information is given to decide.

The SCAT Series provides tests at four levels of difficulty with equivalent forms at each level. This researcher will use Level 2, Form B, Grades 10-12.

2. A semantic differential questionnaire[1] was utilized to elicit student opinions with regard to their academic program and achievement. The specific items of the questionnaire were concerned with student opinions of the following areas:

a. Shop Teacher

b. Shop Course

c. English Teacher

d. English

e. Math Teacher

f. Mathematics

g. Your Class Schedule

h. Vo-tech

3. An examination and analysis of the following sources of information was conducted:

a. Professional literature

b. Related research

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[1]See Appendix B

c. Publications of the Department of Education

d. Correspondence with recognized authorities in vocational-technical education[1]

e. School visitations -- The Research Coordinating Unit of the Bureau of Vocational, Technical, and Continuing Education made funds available for this study for the researcher to visit area vocational-technical schools in the state.[2]

C. Procedures

1. Sample Schools

Four sample schools, a large full-time AVTS and a small full-time AVTS as well as a large part-time AVTS and a small part-time AVTS constituted the sample population.

2. Sample Students

All senior students enrolled in the trade and industrial program in the four sample schools made up the sample students for this study. Table 2 gives the number of students in each school who completed the SCAT and the semantic differential questionnaire.

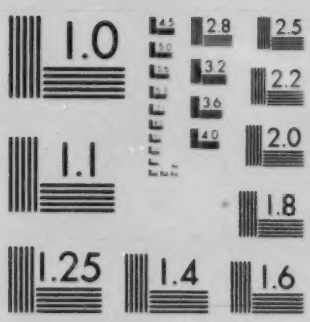
TABLE 2

NUMBER OF SAMPLE STUDENTS AND TYPE OF AVTS

	Full-Time AVTS	Part-Time AVTS
Large	84	185
Small	59	144

[1]See Appendix C

[2]See Appendix D



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

The purpose of the project was discussed and permission to have the school become involved was requested of the respective administrative directors and high school principals. A schedule for testing was developed in conjunction with the various school administrators.

3. School Visitations

The full-time comprehensive area vocational-technical school, part-time area vocational-technical school, and academic high schools were visited and information collected concerning:

a. general academic curriculum

b. supportive academic courses

c. graduation requirements

d. flexibility of scheduling

D. Treatment Of The Data

1. Academic Curriculum Data

Data from the schools concerning general curriculum offerings, supportive academic courses, graduation requirements and flexibility of scheduling was analyzed, compared and summarized. The findings are reported descriptively; and tables were utilized where appropriate to focus on the similarities and differences that exist between full-time area vocational-technical schools and part-time area vocational-technical schools in the context of the academic program.

2. Semantic Differential

A profile analysis of the data gathered by the opinion questionnaire was conducted to determine the differences and similarities of student opinion in full-time area vocational-technical schools and part-time

area vocational-technical schools concerning their academic program and achievement. By plotting the profiles of mean response patterns between comparison groups on a set of scales, similarities or differences in the profiles can be observed. If there are consistently greater means for one group than for the other, such that their profiles tend to stand apart, the statistical probability of such a consistent difference can be tested by referring to a binomial probability table.[1] Tables and graphs were developed to display the data. Included is information about the group mean scores for the two schools, the item being evaluated and the various scales, and bipolar adjectives.

3. School And College Ability Test

The data generated by the Series II of the School and College Ability Test (SCAT II) was treated statistically. A multivariate analysis of variance was performed to examine differences among population means for each of the separate areas of the SCAT (Hypothesis Two). The design included two factors, type and size of school. A detailed analysis of the relationship of academic achievement and type of school, full-time AVTS and part-time AVTS was conducted. Analysis of the relationship of academic achievement and size of school, large AVTS and small AVTS (with regard to student enrollment) was also performed to determine if any differences existed.

The Department of Measurement and Evaluation of the University of Pittsburgh made computer programs available to treat the data collected by the SCAT.

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[1]S. Isaac and W. Michael, Handbook in Research and Evaluation (San Diego, California, Robert L. Knapp, Publisher, 1971), p. 103.

CHAPTER IV

PRESENTATION AND DISCUSSION OF THE DATA

A. Description Of The Sample

The sample population for this study included all seniors in the trade and industrial courses of the four sample schools. Because of the diverse nature of the vocational-technical offerings in area vocational-technical schools the students who responded to the various research instruments came from numerous shop areas.[1]

In Table 3 information concerning the sample schools and number of sample students is reported.

TABLE 3

ENROLLMENT AND TYPE OF SHOP/ACADEMIC SCHEDULE

School	Enrollment	Sample Students	School Schedule
Large Full-Time AVTS	1500	185	One Week/One Week
Small Full-Time AVTS	500	84	One-Half Day/One-Half Day
Large Part-Time AVTS	1400	144	Two Weeks/Two Weeks
Small Part-Time AVTS	480	59	One-Half Day/One-Half Day

The small full-time AVTS had a student enrollment of 500 of which 84 seniors in the trade and industrial courses participated in this study.

[1] See Appendix E

The large full-time AVTS had a student enrollment of 1500 of which 185 seniors in the trade and industrial courses were involved in the study. The small part-time AVTS had a student enrollment of 480 and 59 seniors in trade and industrial courses participated in this study. The large part-time AVTS had a student enrollment of 1400 of which 144 seniors were involved in this study.

Students in each of the sample schools were scheduled into classes in a different manner. In the small part-time AVTS the students attend the AVTS one-half day either morning or afternoon and received their academic instruction at their home school. In the large part-time AVTS the students attend the AVTS for two full weeks and then returned to their respective high schools for two full weeks of academic instruction. In the small full-time AVTS students attended shop for one-half a day either in the morning or afternoon session and received the academic instruction in the AVTS during the alternate, morning or afternoon, session. In the large full-time AVTS students received shop instruction on a week-about basis (with the shop week followed by a week of academic instruction).

B. Hypothesis Analysis

Hypothesis One: There will be no differences between academic programs of full-time area vocational-technical schools and part-time area vocational-technical schools with regard to:

a. general academic curriculum

b. supportive academic course offerings

c. graduation requirements

d. flexibility of student scheduling

Small Part-Time AVTS

The small part-time area vocational-technical school had five schools participating in the program. Students attend the area vocational-technical school on a one-half day basis either in the morning or afternoon session. During the other time period the vocational-technical students received their academic program in the participating high school. Each of the five high schools has a seven-period day; students who attended the vocational-technical school spend three periods in the vocational-technical school, one period for lunch and traveling to the home high school or the vocational-technical school and three periods in academic classes. A summary of the academic course requirements for vocational students in the five participating high schools is shown in Table 4.

TABLE 4

ACADEMIC SUBJECT UNITS REQUIRED FOR GRADUATION IN EACH SCHOOL (10, 11, 12) PARTICIPATING IN THE SMALL PART-TIME AVTS

School	Periods In Day	English	Social Studies	Science	Functional Math	Phy. Ed. Health	Elective
A	7	3	2	1	1	1	1
B	7	3	2	1	1	1	1
C	7	3	2	1	1	1	1
D	7	3	2	1	1	1	1
E	7	3	2	1	1	1	1

As is indicated above students who attend the small part-time AVTS had the opportunity to take one elective course in a three-year period. The general academic curriculum of the five participating schools for vocational-technical students is designed to meet state minimum requirements.

The functional mathematics class was related to shop and laboratory work. The intent is to assist the students in developing mathematical

skills needed in their shop and laboratory work experience.

With regard to the flexibility of student scheduling the five participating high schools of the small part-time AVTS attempted to block schedule their vocational-technical students. Thus, vocational students receive their academic program with other vocational students. However, a few exceptions existed.

Large Part-Time AVTS

The large part-time area vocational-technical school had six schools participating in the program. Students attend the area vocational-technical school on a two-week about basis. Two weeks are spent at the AVTS and are followed by two weeks of academic courses at the home high school. The cycle repeats itself all year with the student taking double periods of each academic subject to complete the course time requirements. All but one of the six high schools has a seven-period day; one school had an eight-period day. A summary of the academic course requirements for vocational students in the six participating schools is shown in Table 5.

TABLE 5

ACADEMIC SUBJECT UNITS REQUIRED FOR GRADUATION
IN EACH SCHOOL (10, 11, 12) PARTICIPATING
IN THE LARGE PART-TIME AVTS

School	Periods In Day	English	Social Studies	Science	Math For Voc. Stud.	Phy. Ed. Health	Elective
A	7	3	3	1	1	1	1
B	7	3	3	1	1	1	1
C	7	3	3	1	1	1	1
D	7	3	3	2	2	1	0
E	7	3	3	1	1	1	1
F	8	3	3	1	1	1	2

As is indicated in the previous table, students who attended the large part-time AVTS had the opportunity to take one elective in four of the six high schools, no elective in one high school, and two electives in another high school. The general academic curriculum of the six participating schools is designed to meet state minimum requirements. School D was exceeding the minimum requirements by requiring an additional credit in both science and mathematics.

The mathematics for vocational students was closely related to shop and laboratory work and was an attempt to provide students with the opportunity to apply their knowledge of mathematics to the practical problems of shop work.

In examining the scheduling procedures in the six schools which participate in the large part-time AVTS program the data revealed that the vocational students follow a predetermined program. Basically, all vocational students are block scheduled into two weeks about and follow the same type of academic schedule for a three-year period.

Small Full-Time AVTS

The small full-time AVTS has ten schools which participate in the program by sending students on a full-time basis for both their trade and academic courses.

After completion of their eleventh and twelfth grade program at the AVTS the students were graduated from their participating high school. Students attended shop classes four periods either in the morning or afternoon session, during the alternate session they attended four periods of academic classes.

A summary of the academic course requirements for the small full-time AVTS is shown in Table 6.

TABLE 6

ACADEMIC SUBJECT UNIT REQUIREMENTS
FOR GRADUATION (11, 12) IN THE
SMALL FULL-TIME AVTS

School	Periods In Day	English	Social Studies	Voc. Science	Voc. Math	Phy. Ed. Health	Other	Elective
Small Full-Time	8	2	2	1	2	.6	1	0

Students in the small full-time AVTS did not have the opportunity to select elective courses. The general academic program is designed to meet state minimum requirements; however, an additional course in mathematics was required.

The vocational science and vocational mathematics were closely related to shop experience.

Students were block scheduled by shop area, as an example, auto mechanic students spend the entire day together in both the shop and academic classes. Thus, the vocational science and vocational mathematics courses they attended deal with, in a large measure, the specific scientific and mathematical problems encountered by individuals in that area of work.

Large Full-Time AVTS

The large full-time AVTS had seven schools which participate in the program by sending students on a full-time basis for both their trade and academic courses. Some students attended shop classes on a week-about basis and receive their academic instruction on the alternate week. Other students, because of the nature of their shop, attended shop classes on a one-half day basis either morning or afternoon session, the alternate session is then devoted to academic subjects. The school day contains

nine periods plus a lunch period. Students in the week-about program take double classes of academic subjects every other week to satisfy the course time requirements. Students in the half-day schedule were scheduled into daily sections of required academic courses.

A summary of the academic course requirements in the large full-time AVTS is shown in Table 7.

TABLE 7

ACADEMIC SUBJECT UNIT REQUIREMENTS
FOR GRADUATION (10, 11, 12) IN THE
LARGE FULL-TIME AVTS

School	Periods In Day	English	Social Studies	Science	App. Math	Phy. Ed. Health	Other	Elective
Large Full-Time	9	3	2	1	2	1.2	2	3

As indicated above, students in the large full-time AVTS have the opportunity to select three electives. The general academic program meets state minimum requirements and, in addition, requires an extra credit in mathematics as well as providing the student with several electives.

The applied mathematics was closely related to the shop and laboratory work experiences.

Students were independently and individually scheduled; however, all students who were on a week-about schedule did not mix into the daily classes.

In summation, the senior students in full-time AVTS seemed to have more academic requirements than the senior students in part-time AVTS. This difference was associated with the greater number of periods in the school day which permitted more opportunity to take academic courses.

Closely related were the graduation requirements which were higher in full-time AVTS than part-time AVTS. The only supportative academic course appeared to be mathematics which was offered in all four sample schools. With regard to the flexibility of student scheduling the data and school visits revealed that student scheduling practices in the four sample schools were relatively inflexible. Very few of the sample students were scheduled into academic classes other than those attended by other trade and industrial students.

Hypothesis Two: There will be no significant differences in the verbal ability and math achievement of students in full-time AVTS and part-time AVTS.

Hypothesis Three: There will be no significant differences in the verbal ability and math achievement of students in large AVTS (part-time and full-time) and small AVTS (part-time and full-time).

Hypotheses two and three were tested by utilizing a multivariate analysis of variance on the data generated by the School and College Ability Test which was administered to students in the four sample AVTS. Input parameters consisted of two variables, mathematics and verbal scores, in the input vectors. There were two factors, type of school and size of school, in the design. The two levels of the factors in the design included:

a. Type of School
   1. Part-time
   2. Full-time
b. Size of School
   1. Small
   2. Large

The data in Table 8 presents the cell identifications and frequencies.

TABLE 8

POPULATION DISTRIBUTION

	Small (1)	Large (2)
Full-Time (1)	Cell 1 n= 84	Cell 2 n= 185
Part-Time (2)	Cell 3 n= 59	Cell 4 n= 144

Total n = 472

Verbal Ability

Mean scores and standard deviations were calculated for the verbal ability variable in the four sample schools yielding the results reported in Table 9.

TABLE 9

VERBAL ABILITY

	Small AVTS	Large AVTS
Full-Time	Mean = 26.17 S.D. = 7.42	Mean = 27.49 S.D. = 7.02
Part-Time	Mean = 27.24 S.D. = 7.08	Mean = 23.15 S.D. = 7.94

A mean of 26.83 was computed for the combined data in Cell 1--Small Full-Time AVTS and Cell 2--Large Full-Time AVTS for verbal ability. A mean of 25.19 was obtained from the combined data in Cell 3--Small Part-Time AVTS and Cell 4--Large Part-Time AVTS for verbal ability.

Application of an F-test of mean differences, at the .05 level of significance for $F_{1,468}$ is equal to 3.86. An F value of 4.7513 with 468 degrees of freedom lies in the rejection region. Therefore, the null hypothesis was rejected for hypothesis two, and the researcher concluded that students in a full-time AVTS score higher in verbal ability than do students attending a part-time AVTS.

A mean of 26.70 was computed for the combined data in Cell 1--Small Full-Time AVTS and Cell 3--Small Part-Time AVTS for verbal ability. A mean of 25.32 was computed from the combined data in Cell 2--Large Full-Time AVTS and Cell 4--Large Part-Time AVTS for verbal ability. Application of an F-test of mean differences, at the .05 level of significance resulted in an F ratio of 3.4133. The critical value for this test is an $F_{1,468}$ equal to 3.86. Therefore, rejection of the null hypothesis for hypothesis three was not warranted. Thus, although students in small AVTS had a slightly higher mean score for verbal ability than students in large AVTS, this small difference was not significant.

Mathematical Achievement

Mean scores and standard deviations were calculated for the mathematical achievement variable in the four sample schools yielding the results reported in Table 10.

TABLE 10

MATHEMATICAL ACHIEVEMENT

	Small AVTS	Large AVTS
Full-Time	Mean = 27.18 S.D. = 7.86	Mean = 26.83 S.D. = 7.09
Part-Time	Mean = 25.52 S.D. = 6.58	Mean = 18.48 S.D. = 6.17

A mean of 27.01 was calculated for the combined data in Cell 1--Small Full-Time AVTS and Cell 2--Large Full-Time AVTS for mathematical achievement. A mean of 22.00 was computed for the combined data in Cell 3--Small Part-Time AVTS and Cell 4--Large Part-Time AVTS for mathematical ability.

An F-test of mean differences, at the .05 level of significance, for $F_{1,468}$ is equal to 3.86. An F value of 50.92 with 468 degrees of freedom does permit rejection of the null hypothesis for hypothesis two, and the researcher concluded that students in full-time AVTS score higher in mathematical achievement than do students attending part-time AVTS.

A mean of 26.35 was computed for the combined data in Cell 1--Small Full-Time AVTS and Cell 3--Small Part-Time AVTS for mathematical achievement. A mean of 22.66 was computed for the combined data in Cell 2--Large Full-Time AVTS and Cell 4--Large Part-Time AVTS for mathematical achievement. An F-test of mean differences, at the .05 level of significance, yielded an F ratio of 27.793. The critical value for $F_{1,468}$ is equal to 3.86; thus, on the basis of this test, it was concluded that a

significant relationship does exist. Therefore, the null hypothesis for hypothesis three was rejected and the researcher concluded that students in small AVTS score higher in mathematical achievement than students in large AVTS.

Interaction Analysis

An interaction analysis of the type of school, full-time AVTS or part-time AVTS, and size of school, large AVTS or small AVTS, was conducted. An F ratio of 13.010 for the verbal ability variable was calculated to be significant at the .05 level of significance, and the null hypothesis was rejected. Thus, this researcher concluded that based on the information reported in Table 9 the senior students in the full-time AVTS scored lower than the senior students in the part-time AVTS in the small AVTS. The senior students in full-time AVTS scored higher than senior students in part-time AVTS in the large schools.

An F ratio of 22.83 was calculated for the mathematical ability variable and determined to be significant at the .05 level. The null hypothesis was rejected and based on the data in Table 10, the researcher concluded that the senior students in the full-time AVTS scored higher than the senior students in the part-time AVTS for both large and small AVTS.

Thus, in the four sample schools the data from the SCAT revealed that the senior students in the full-time AVTS scored significantly higher in verbal ability and mathematical achievement than did the senior students in the part-time AVTS. When the data were treated with regard to size of school, the senior students in the small AVTS scored significantly higher in mathematical achievement and slightly higher in verbal ability than did the sample students in large AVTS. The interaction analysis revealed that

the senior students in the full-time AVTS scored higher in verbal ability and mathematical achievement than senior students in part-time AVTS in both large and small AVTS with the exception that part-time students in the small AVTS scored higher for the verbal ability test.

Hypothesis Four: There will be no differences between student opinions of academic programs and achievement in full-time area vocational-technical schools and part-time area vocational-technical schools.

The use of rating scales as a device for evaluating attitudes of learners was developed by Good.[1] The semantic differential scales, developed by Osgood, et. al, seems ideally suited for the purposes of this study.[2] The semantic differential is a method for measuring the meaning or concept of various items with regard to a seven unit, a + 3 to a - 3, scale and various bipolar adjectives.

Analysis of the eight semantic differentials for the part-time AVTS and the full-time AVTS was performed utilizing a profile analysis method.[3] Scaled data of the semantic scales was evaluated by computing group means for each of the scales. Group means [4] for each set of bipolar adjectives were computed by multiplying the frequency of response for each column by the weighted factor associated with that column, summing these products and dividing by the total responding. The profile means were then plotted on a

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[1]Carter Good, Dictionary of Education Prepared Under The Auspices of Phi Delta Kappa, 2nd Edition, (New York: McGraw-Hill, 1969).

[2]C. E. Osgood, G. L. Suci, and P. H. Tannenbaum, The Measurement of Meaning (Urbana, Ill.: University of Illinois Press, 1957).

[3]S. Isaac, and W. Michael, Handbook in Research and Evaluation (San Diego, California, Robert R. Knapp, Publisher, 1971).

[4]See Appendix F

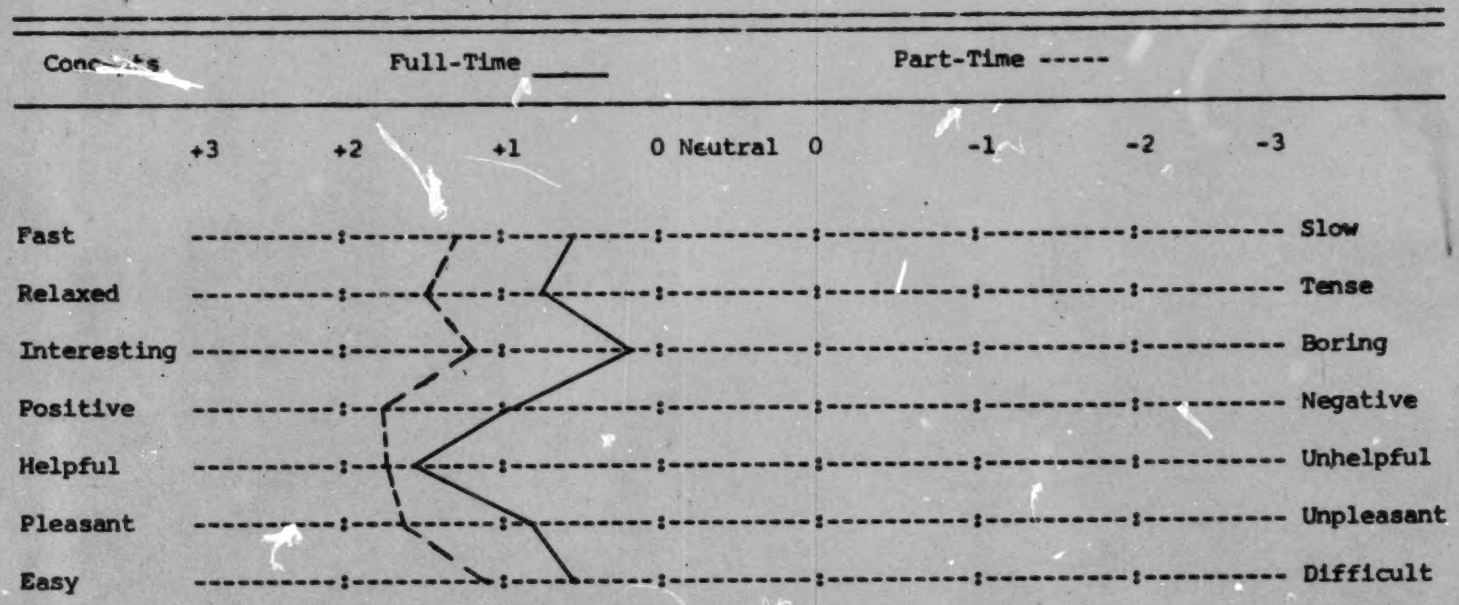
set of scales for observation. A sign test of the profile patterns, at the P=.05 level of significance was utilized to determine statistical difference.

On the basis of the data reported in the following tables, hypothesis four is rejected for the following items: shop teacher, shop course, English, math teacher, your class schedule, and Vo-tech school. The profile analysis yielded a P value less than .05 for these items to warrant rejection of the null hypothesis. Analysis of Tables 11 and 12 reveals that the senior students in part-time AVTS had a significantly more favorable opinion about the items shop teacher and shop course than did the senior students in full-time AVTS. Tables 14, 15, 17, and 18 reveal that senior students in full-time AVTS had a significantly more favorable opinion about the items English, math teacher, your class schedule, and Vo-tech school than did the senior students in part-time AVTS.

A profile analysis of the items English teacher and mathematics yielded P values greater than .05 the critical value and therefore did not permit rejection of the null hypothesis. The data reported in Table 13, English teacher, and Table 16, mathematics, indicate senior students in full-time AVTS had a slightly more favorable opinion about these items than did the senior students in part-time AVTS.

TABLE 11

FULL-TIME AVTS AND PART-TIME AVTS
PROFILE ANALYSIS OF SHOP TEACHER



N = 7, X = 0, P = .008

TABLE 12

FULL-TIME AVTS AND PART-TIME AVTS
PROFILE ANALYSIS OF SHOP COURSE

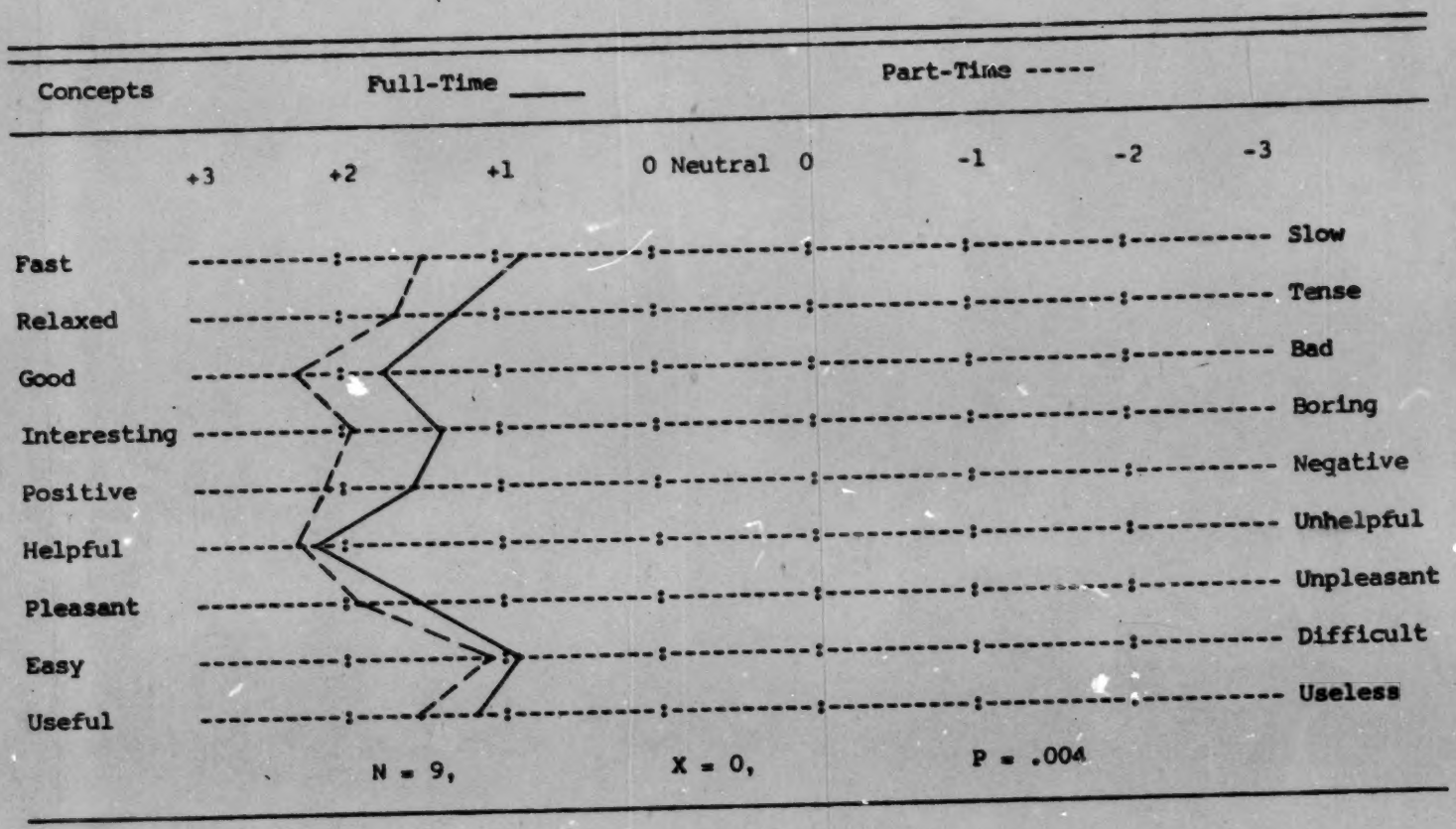
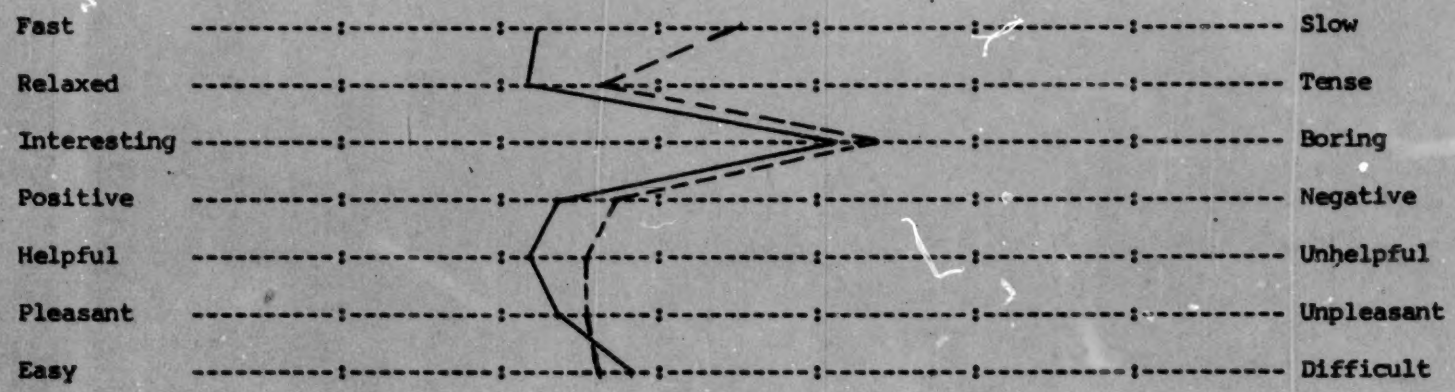


TABLE 13

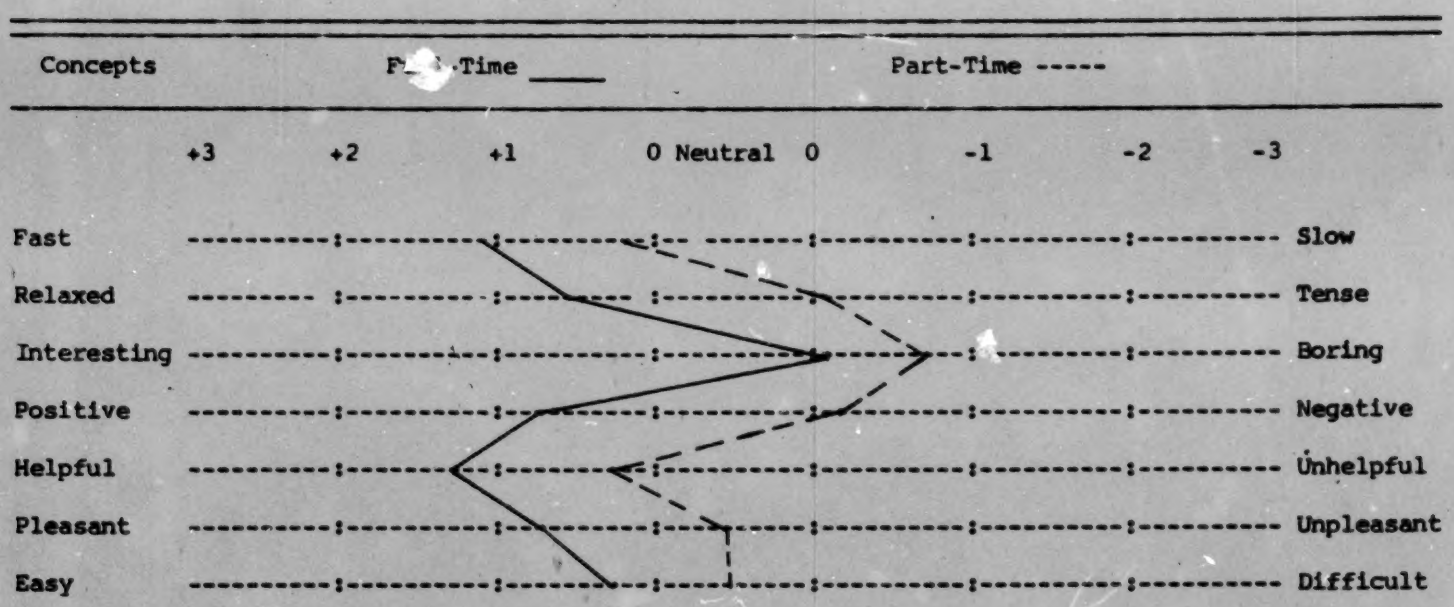
FULL-TIME AVTS AND PART-TIME AVTS
PROFILE ANALYSIS OF ENGLISH TEACHER



N = 7, X = 1, P = .124

TABLE 15

FULL-TIME AVTS AND PART-TIME AVTS
PROFILE ANALYSIS OF MATH TEACHER



N = 7, X = 0, P = .016

TABLE 16

FULL-TIME AVTS AND PART-TIME AVTS
PROFILE ANALYSIS OF MATHEMATICS

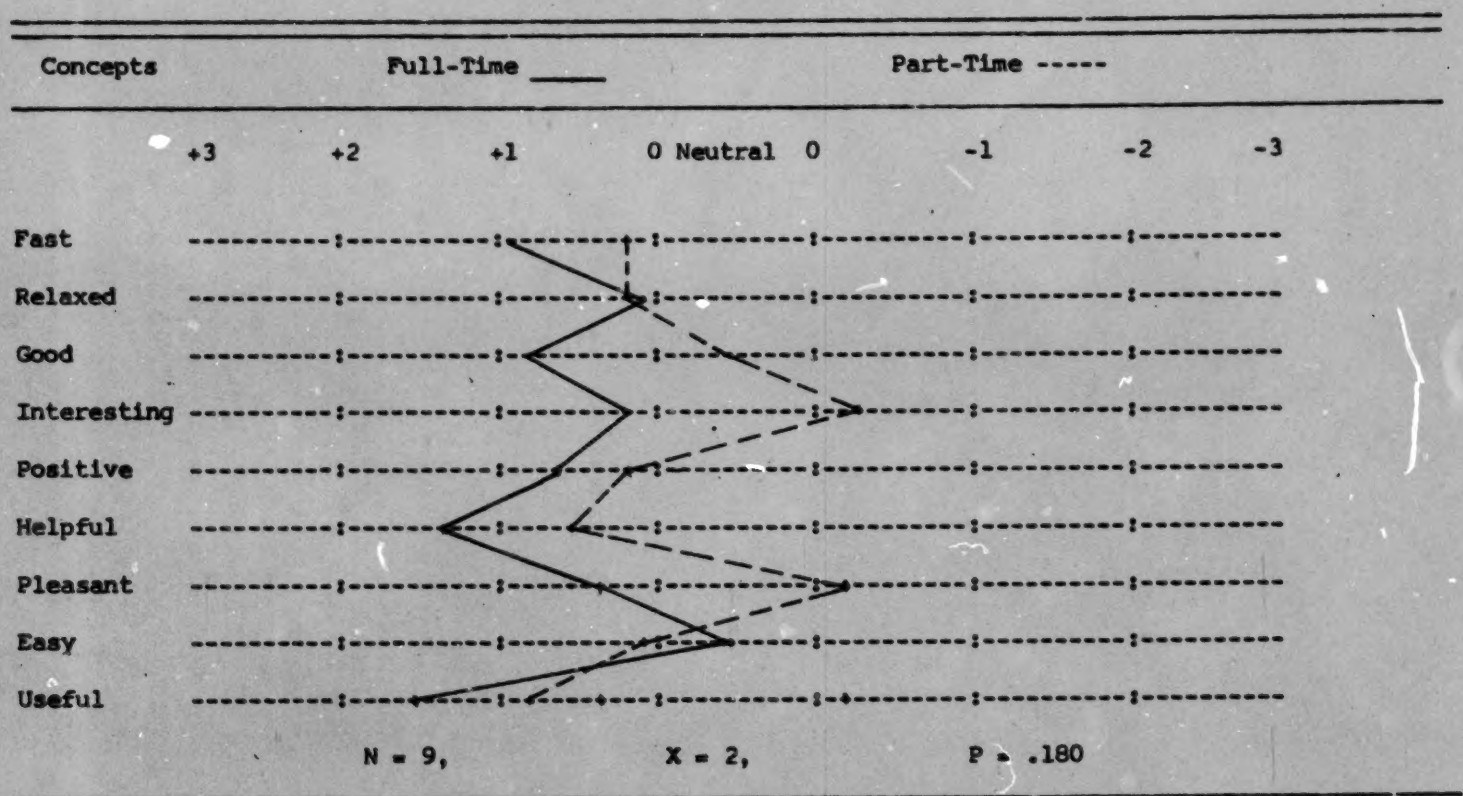


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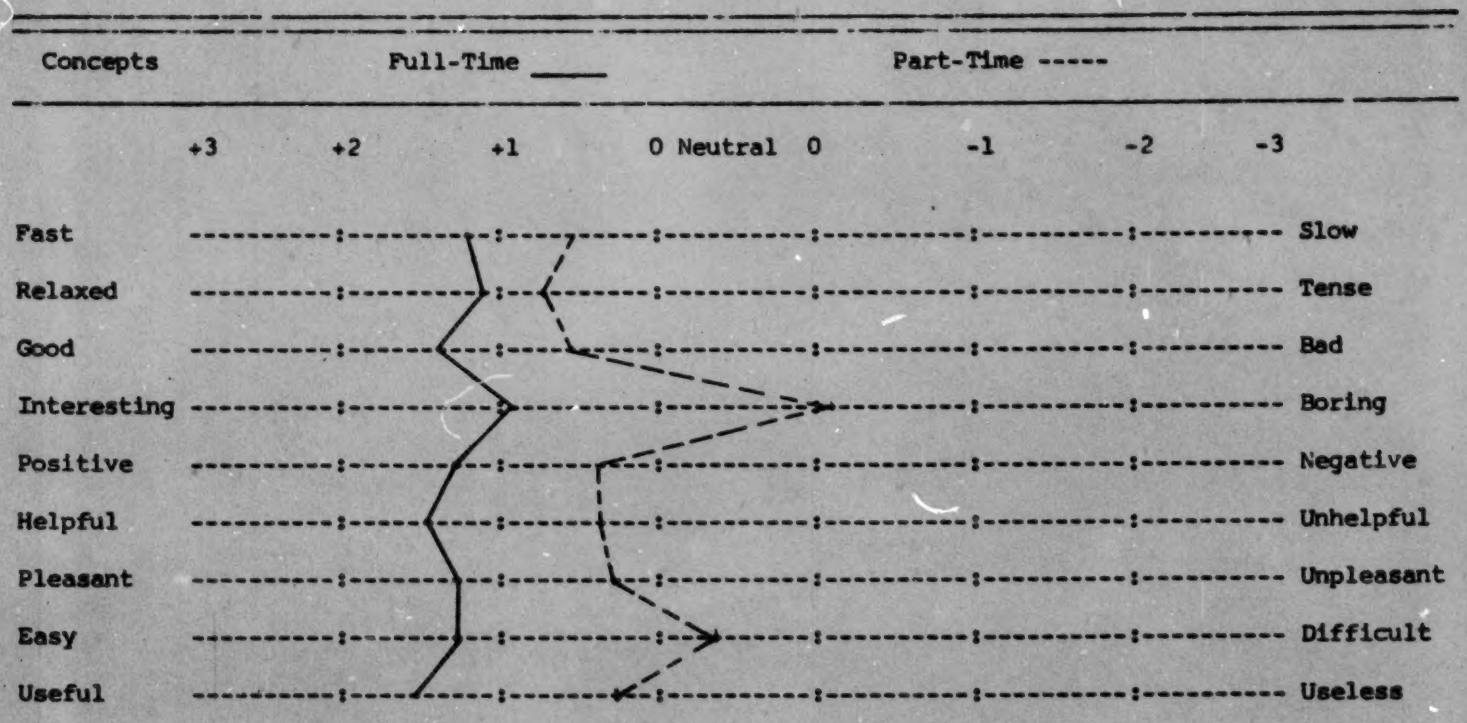
TABLE 17

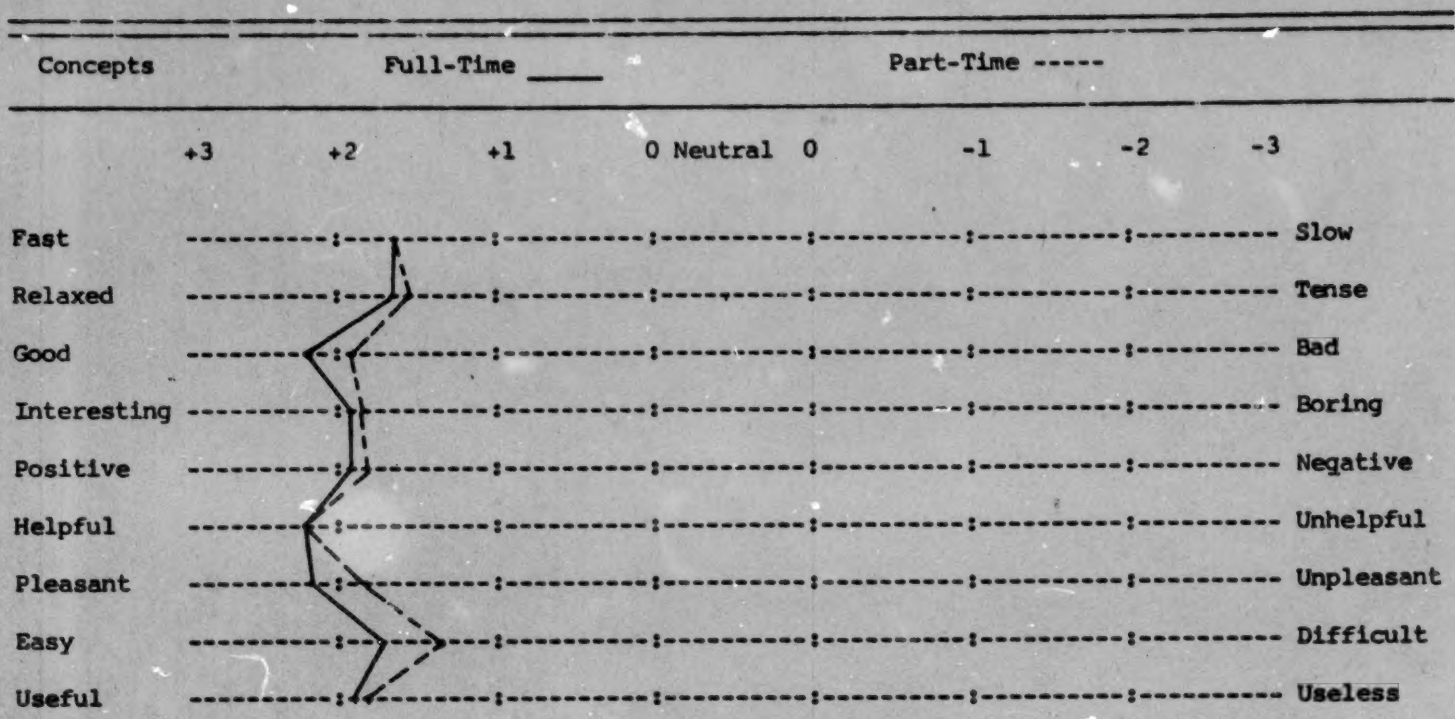
FULL-TIME AVTS AND PART-TIME AVTS
PROFILE ANALYSIS OF YOUR CLASS SCHEDULE



N = 9, X = 0, P = .004

TABLE 18

FULL-TIME AVTS AND PART-TIME AVTS
PROFILE ANALYSIS OF VO-TECH SCHOOL



N = 9, X = 0, P = .004

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Thus, analysis of the data from the semantic differential revealed similar trends in opinions held by full-time and part-time AVTS students with regard to the vocational and academic items. However, significant differences did appear for six of the eight semantic differential revealing that part-time sample students tended to favor their shop course and shop teacher more than full-time AVTS sample students, while the full-time AVTS students tended to favor their English teacher, English course, math teacher, class schedule, and Vo-tech school more than the part-time AVTS students. Students in both full-time AVTS and part-time AVTS had a more favorable opinion of the items shop teacher, shop course, and Vo-tech school than they did of the items associated with the academic program.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER STUDY

A. The Research Problem

The purpose of this study was to investigate academic achievement of students, academic programs, and student opinion in full-time area vocational-technical schools as compared to part-time area vocational-technical schools.

A review of the literature pertinent to this study did not reveal any consensus of opinion concerning which school setting, full-time or part-time, might provide a climate more conducive to academic achievement.

A SCAT, Series II, form B, was utilized to obtain data about verbal ability and mathematical ability. A semantic differential questionnaire was constructed to obtain data about student opinions and feelings. Finally, visits were made to the sample schools and materials collected to provide the data about course offerings, graduation requirements and flexibility of student scheduling. The data for the SCAT and the semantic differential were gathered from the following: (1) 84 seniors in trade and industrial courses in a small, full-time area vocational-technical school; (2) 185 seniors in trade and industrial courses in a large, full-time area vocational-technical school; (3) 59 seniors in trade and industrial courses in a small, part-time area vocational-technical school; and (4) 144 seniors in trade and industrial courses in a large, part-time area vocational-

technical school. The sample students represent all seniors in the trade and industrial courses of the four sample AVTS. The data obtained from the SCAT, the semantic differential and the school visits provided the basis for hypothesis testing.

B. Hypotheses, Findings, and Conclusions

In order to accomplish the purposes of the study the following four hypotheses were formulated and tested.

Hypothesis One: There will be no differences between academic programs of full-time area vocational-technical schools and part-time area vocational-technical schools with regard to:

a. general academic curriculum

b. supportative academic course offerings

c. graduation requirements

d. flexibility of student scheduling

After careful analysis of the data gathered from the four sample schools and the development of tables to closely examine trends and directions the following conclusions were made.

a. General Academic Curriculum

The four sample schools provide a similar academic program to students enrolled in the trade and industrial vocational courses. Each school's academic course requirements are alike in the areas of English, science, health and physical education. The full-time schools require one more credit in mathematics than do the participating high schools of the part-time AVTS. Students attending the large part-time AVTS are required to take an additional social studies course in their participating high schoools

over what is required of students in the other sample schools involved.

b. Supportative Academic Course Offerings

The only specific supportative academic course offering required of students in each setting was a shop mathematics. In the participating high schools of the small part-time AVTS students are required to take one credit of functional math. Students in the large part-time AVTS receive one credit of math for vocational students in their home academic high school. In the small full-time AVTS students are required to take two credits of vocational mathematics, while students in the large full-time AVTS are required to carry two credits of applied mathematics.

c. Graduation Requirements

Students are required to earn 13 credit units in three of the sample schools for graduation; however, in the large full-time AVTS 16 credit units are required for graduation.

d. Flexibility of Student Scheduling

Student scheduling of academic courses is more difficult in part-time AVTS, the trend in the sample schools was to block schedule the vocational students together. Thus, students in the small part-time AVTS get their academic program either in the morning or afternoon session with other vocational students--there is little evidence of mixing these students in academic courses with students at the home school who have not elected to attend the AVTS. The students who attend the large part-time AVTS get double periods of academic courses every two weeks are again not mixed with the students in their home high schools who do not attend the AVTS. In the small full-time AVTS the students are block scheduled by vocational area. Thus, machine shop students go to all classes as a group

during their experience at the AVTS. Students in the large full-time AVTS get their academic instruction on a week-about basis, again taking double periods of courses every other week. These students as a result of the week-about schedule are, therefore, not able to mix into classes with daily students who are involved in a half-day shop experience.

Supportative academic course offerings and flexibility of student scheduling as related to hypothesis one were accepted as a result of the findings. However, general academic curriculum and graduation requirements related to hypothesis one were rejected because differences do exist.

Little evidence exists to show a high degree of relationship between the shop and academic courses whereby the academic course would tend to specifically support the student in his shop experience. The only exception was the mathematics course in which each sample school was attempting to provide a mathematics course which was practical and closely related to the shop experiences in content. An aspect of the findings the writer viewed as disturbing was the fact that student scheduling was so restrictive. In the four sample schools the schedules for students who elect to take the trade and industrial courses prohibit them from associating with technical students in class. Thus, the result is to prolong the old stigma of being a "shoppy" which is an outgrowth of this type of inflexible student scheduling.

The differences which were found to exist in the sample schools with regard to general academic curriculum and graduation requirements seem to be associated with the number of periods the daily schedule contained, not the type of school. The full-time AVTS with more periods in a day were able to offer more courses to their students and require more than the state minimum for graduation.

Hypothesis Two: There will be no significant differences in the verbal ability and mathematics achievement of students in full-time area vocational-technical schools and part-time area vocational-technical schools.

a. Verbal Ability in Full-Time and Part-Time AVTS

A multivariate analysis of variance was performed in order to determine the relationship between the verbal scores on the SCAT of students in part-time AVTS and full-time AVTS. The computed statistic, 4.7513, when subjected to an F-test at the .05 level of significance, was found to be in the rejection region. Therefore, the null hypothesis was rejected. Thus, the researcher concluded that students in the full-time AVTS do differ significantly in verbal ability from students in the part-time AVTS in the sample schools.

b. Mathematical Achievement in Full-Time and Part-Time AVTS

In terms of mathematical achievement an F-test of mean differences at the .05 level of significance yielded an F value of 50.92 which resulted in the rejection of the hypothesis. Thus, the researcher concluded that a significant difference does exist between students in full-time and part-time AVTS for mathematical ability. Such reasoning is also supported by the findings related to hypothesis one in that students in the full-time AVTS are required to schedule an additional year of mathematics study beyond that required of the students in the part-time AVTS.

The mean score differences for verbal ability and mathematical ability of students in the full-time and part-time AVTS produced a greater spread for mathematical ability than verbal ability as indicated in Table 19.

TABLE 19

MATH AND VERBAL MEAN SCORE DIFFERENCES

	Full-Time AVTS Mean Score	Part-Time AVTS Mean Score	Difference
Math	27.01	22.00	5.01
Verbal	26.83	25.19	1.64

Thus, it would appear that students in the part-time AVTS experienced much greater difficulty with the mathematical ability test instrument than did the students in the full-time AVTS.

Hypothesis Three: There will be no significant differences in the verbal ability and mathematics achievement of students in large AVTS (part-time and full-time) and small AVTS (part-time and full-time).

a. Verbal Ability in Large and Small AVTS

A multivariate analysis of variance was performed in order to determine the relationship between verbal scores on the SCAT of students in large AVTS and small AVTS. The computed statistic 3.4133, when subjected to an F-test at the .05 level of significance, did not warrant rejection of the null hypothesis. Thus, even though a difference exists between verbal ability scores of students in large AVTS and small AVTS, the difference is not significant.

b. Mathematics Achievement in Large and Small AVTS

In terms of mathematics achievement an F-test of mean difference at the .05 level of significance yielded an F value of 27.793 which resulted in the rejection of the hypothesis. Thus, the researcher concluded that students in small AVTS scored significantly higher than students in

large AVTS.

The data reported in Table 20 provides a basis of comparison for large AVTS and small AVTS.

TABLE 20

LARGE AND SMALL AVTS MATH AND VERBAL
MEAN SCORE DIFFERENCES

	Small AVTS Mean Score	Large AVTS Mean Score	Difference
Math	26.35	22.66	3.69
Verbal	26.70	25.32	1.38

Interaction Analysis

An interaction analysis of the verbal ability data yielded an F value of 13.010 which was significant at the .05 level. Thus, the researcher concluded the students in the small AVTS scored higher in the part-time AVTS than the full-time AVTS. In the large AVTS the students scored higher in full-time AVTS than part-time AVTS. The interaction analysis of the mathematics achievement data yielded an F value of 22.83 which was significant at the .05 level. Thus, the researcher concluded the full-time students in large and small AVTS scored higher than the students in the part-time AVTS.

Thus, as a result of the study this researcher concluded that in the four sample schools using the SCAT instrument to determine verbal and mathematical achievement there is a statistical difference between the performance of senior trade and industrial students in full-time AVTS and part-time AVTS. Students in the full-time AVTS scored significantly higher in verbal ability and mathematical achievement than did the students in the

part-time AVTS. When combining students in part-time AVTS and full-time AVTS, students in the small AVTS scored significantly higher in mathematical achievement and slightly higher in verbal ability than did students in large AVTS.

Hypothesis Four: There will be no difference between student opinions of academic programs and achievement in full-time area vocational-technical schools and part-time area vocational-technical schools.

Analyses of the semantic differential questionnaire provided data to test hypothesis four for the following items:

1. Shop Teacher
2. Shop Course
3. English Teacher
4. English
5. Math Teacher
6. Mathematics
7. Your Class Schedule
8. Vo-Tech School

A sign test of the profile patterns, profile analysis, at the P=.05 level of significance was utilized to determine statistical differences.

Item: Shop Teacher

Analysis of the data for the item Shop Teacher yielded a P value of .008 which did permit rejection of the null hypothesis. This researcher concluded that students in part-time AVTS consistently held a more favorable opinion about their concept of shop teacher than did students in the full-time AVTS.

Item: Shop Course

The analysis of the item Shop Course yielded a P value of .004 which permitted rejection of the null hypothesis. Thus, students in the part-time AVTS were consistently more favorable toward the item shop course when asked to express their opinion than were the students in the full-time AVTS.

Item: English

Analysis of the item English yielded a P value of .040 which was significant. This researcher concluded that students in full-time AVTS had a more favorable opinion about English than did students in part-time AVTS.

Item: Math Teacher

A P value of .016 was computed for the item Math Teacher which did permit rejection of the null hypothesis. Thus, it was determined that students in full-time AVTS had a more favorable opinion of the item math teacher than did students in part-time AVTS.

Item: Your Class Schedule and Vo-Tech School

P values of .004 were calculated for the item Your Class Schedule and the item Vo-Tech School, both of which were significant and did permit rejection of the null hypothesis. Therefore, it was concluded that students in full-time AVTS had a consistently more favorable opinion about their class schedule and the Vo-Tech school than did students in part-time AVTS.

Additional Data

Analysis of the item English Teacher yielded a P value of .124

which did not fall within the critical region and therefore did not warrant rejection of the null hypothesis. A P value of .180 was computed for the item Mathematics which did not permit rejection of the null hypothesis. This researcher concluded that students in full-time AVTS and part-time AVTS had similar opinions about the item English Teacher and the item Mathematics.

An overall view of the eight semantic differentials tended to reveal that students in both full-time and part-time AVTS had a more favorable opinion about the items Shop Teacher, Shop Course, and Vo-Tech than they did about Math Teacher, Mathematics, English, and English Teacher.

Thus, the data from the semantic differential revealed that students in the part-time AVTS viewed their Shop Teacher and Shop Course more favorably than did the students in full-time AVTS. However, students in the full-time AVTS held a more favorable opinion about English, Math Teacher, Your Class Schedule, and Vo-Tech than did students in part-time AVTS. In both types of school, full-time and part-time, the senior students viewed Shop Teacher, Shop Course, and Vo-Tech more favorably than English, English Teacher, Mathematics and Math Teacher.

If AVTS are going to really have an impact on students, more and better communications need to occur between the vocational staff and the academic staff in AVTS settings. If students are to see the real relationship between their academic course work and a hands on shop experience more exchange of needs will have to occur. The full-time AVTS should be able to resolve this problem, without too much difficulty. The part-time AVTS will have to assign a higher priority if a better understanding of problems and solutions is to be achieved between the AVTS and the various participating academic high schools.

Scheduling practices which result in the separation of large segments of a school's student population should be modified to permit greater student interaction in both full-time AVTS and part-time AVTS.

Quota systems and other devices to limit attendance in AVTS should be carefully examined to assure students who have real desire and need the opportunity of going to the AVTS.

More and better guidance programs need to be developed to assist young people in developing career decisions both prior to attending AVTS and while in attendance.

C. Recommendations For Further Study

(1) The review of research uncovered a very limited number of studies dealing with academic achievement and area vocational-technical high schools. Research is needed in the field of vocational education that will provide more information about the quality of academic programs available to students who elect to attend an AVTS.

(2) This study could be replicated using a broader sample of students including technical students in the sample as well as vocational students in attendance in AVTS.

(3) Vocational education is offered in various settings such as the part-time AVTS, full-time AVTS, comprehensive high school and in private facilities. A study needs to be done to show which organizational plan is most beneficial to students with regard to their academic achievement.

(4) A study could be made of academic achievement and student scheduling patterns in AVTS. Students are scheduled in various ways which may or may not have implications for their ability to perform at their best in academic classes. These scheduling patterns include: half-day about, day

about, week about, two-week about, six-week about, or any other schedule which the Department of Education would approve.

(5) This study could be followed up by a longitudinal study covering the three-year period of enrollment in the AVTS by having students take a pre-test during their first year of attendance in an AVTS followed up with a post-test following the completion of their senior year.

(6) A replication of this study could be made to compare academic achievement in other cognitive areas as it relates to full-time AVTS and part-time AVTS and student achievement.

In conclusion, it is recommended that research be undertaken to probe the reasons for significant differences between academic achievement and school setting. If more effort needs to be made to better coordinate the academic program and the vocational program with the ultimate goal being making educational experiences more relevant for students, then research should be conducted to move the area vocational-technical school concept in that direction more rapidly.

APPENDICES

APPENDIX A

AREA VOCATIONAL-TECHNICAL SCHOOL CONSTRUCTION AND FUNDING 1964-1973

School	Pupil Capacity	Const. Contract Awarded	Total Cost of Project	Allocation Vocational Ed. Act of 1963 & 1968	Federal Fd Appalachia Regional Dev. Act
1964-65					
Fayette County	1200	Jan. 65	$ 2,086,277	$ 264,549	
Carbon County	672	Mar. 65	1,600,000	310,358	
Lenape	500	Apr. 65	1,008,319	169,730	
Upper Bucks Co.	680	May 65	1,735,000	377,958	
Bucks County	700	June 65	1,885,000	437,761	
Eastern Mont. Co.	840	June 65	2,773,836	833,522	
1965-66					
Central Mont. Co.	840	May 66	$ 2,830,000	$ 431,115	
North Montco	840	May 66	2,535,000	448,582	
Lawrence County	880	June 66	4,845,732	358,034	$ 358,034
Western Mont. Co.	500	June 66	2,286,479	350,582	
Central Chester Co.	966	June 66	3,327,754	577,285	
1966-67					
Lebanon County	700	Sept. 66	$ 3,496,918	$ 594,294	
Pittsburgh	1680		3,043,725	532,651	
Crawford County	600	Nov. 66	2,679,096	585,907	$ 585,907
Erie County	760	Jan. 67	3,692,092	665,284	665,284
West Side	700	Feb. 67	$ 3,375,625	$ 286,058	$ 286,058
Delaware Co. #1	600	Feb. 67	2,365,972	350,305	
Delaware Co. #2	1000	Feb. 67	3,387,962	573,908	
Delaware Co. #3	1100	Feb. 67	3,606,066	595,[illegible]	
Schuylkill Co.-N.	590	Feb. 67	$ 2,200,000	$ 492,239	$ 492,239
Juniata-Mifflin	680	Feb. 67	2,730,000	574,026	574,026
Berks Co.-East	840	Feb. 67	2,991,573	552,137	
Berks Co.-West	840	Feb. 67	3,073,427	545,629	
Schuylkill Co.-S	660	Mar. 67	$ 2,650,000	$ 563,532	$ 563,532
Forbes Trail	880	Apr. 67	3,115,000	525,955	525,955
Reading-Muhlenberg	1280	Apr. 67	4,125,000	795,000	
Centre County	990	May 67	4,474,250	690,552	454,000

Buildings Constructed and Funded (Continued)

School	Pupil Capacity	Const. Contract Awarded	Total Cost of Project	Allocation Vocational Ed. Act of 1963 & 1968	Federal Fd Appalachia Regional Dev. Act
1967-68					
Parkway West	1000	June 67	$ 4,573,868	$ 646,889	$ 375,000
Middle Bucks Co.	1200	Aug. 67	5,400,000	763,477	
Northern Chester	800	Oct. 67	4,162,000	237,198	
Columbia-Montour	640	Oct. 67	3,680,000	308,834	162,500
York County	1740	Nov. 67	$ 7,018,000	$ 621,741	
Venango County	690	Nov. 67	3,920,000	631,905	$ 321,801
A. W. Beattie	760	Nov. 67	3,778,370	521,907	315,000
Jefferson-DuBois	680	Jan. 68	4,600,962	369,329	187,500
Franklin County	880	Mar. 68	$ 4,194,256	$ 782,393	
E. Northampton Co.	950	May 68	3,415,000	598,036	
Hazleton Area	920	May 68	4,175,000	804,938	$ 289,000
Clearfield Co.	640	May 68	3,056,261	555,405	346,500
Upper Bucks Co.*	40	Nov. 67	$ 108,090	$ 16,000	
1968-69					
Lancaster-Willow	1350	July 68	$ 4,633,997	$ 837,301	
Lancaster-Mt. Joy	690	July 68	2,859,154	447,142	
Lanc.-Brownstown	720	July 68	3,108,849	497,994	
Bethlehem Area	1320	Aug. 68	4,470,000	641,418	
Greene County	480	Aug. 68	$ 1,979,630	$ 318,196	$ 142,500
Dauphin County	1070	Sept. 68	5,995,000	406,957	
Greater Johnstown	1500	Sept. 68	10,311,855	734,933	450,000
Altoona Area	1470	Nov. 68	7,560,000	1,281,487	620,000
Lehigh County	1700	Jan. 69	$ 6,940,000	$ 993,929	
Cumberland-Perry	1200	Apr. 69	4,510,000	819,819	
1969-70					
Mon Valley (Wash.)	660	Mar. 70	$ 3,142,389	$ 478,241	$ 266,000
Warren County	480	Mar. 70	2,619,974	401,981	218,521
SUN Area	840	Mar. 70	4,500,000	728,423	404,074

Buildings Constructed and Funded (Continued)

School	Pupil Capacity	Const. Contract Awarded	Total Cost of Project	Allocation Vocational Ed. Act of 1963 & 1968	Federal Fd Appalachia Regional Dev. Act
1969-70 (Cont.)					
Upper Bucks Co.	54	May 70	$ 170,585	$ 26,774	
Somerset Co.	526	Oct. 70	3,729,413	571,830	$ 329,442
Wilkes-Barre	1073	Sept. 70	8,213,118	109,545	1,413,118
Northumberland Co.	783	Nov. 70	4,415,000	828,402	405,222
Western Area	528	Nov. 70	$ 3,475,000	$ 454,778	$ 299,930
Williamsport CC					
Earth Science		Oct. 70	1,306,211	106,276	172,383
Auto		Oct. 70	1,534,734		406,911
North Fayette Co.	486	Jan. 71	2,858,272	450,204	204,491
1970-71					
Admiral Peary	678	Apr. 71	$ 4,256,997		$ 1,194,281
Monroe County	400	Mar. 71	3,224,185		596,469
Mercer County	807	Sept. 71	4,937,569	$ 711,439	350,000
Lackawanna Co.-N.	484	Sept. 71	4,555,442	525,139	669,694
1971-72					
Lackawanna Co.-S	1110	Dec. 71	$ 7,901,989	$ 1,062,849	$ 582,993
Beaver Co. CC		Jan. 72	1,687,777	187,777	500,000
Cen. Montgomery Exp.		May 72	1,807,256	195,828	
E. Montgomery Exp.		May 72	270,000	23,521	
Butler Co. CC		July 72	907,235		394,398
1972-73					
Forbes Road - *	619	Jan. 73	$ 4,520,034		$ 755,034
Luzerne Co. CC - *	200	Jan. 73	2,353,174	$ 200,000	632,756
Montgomery Co. CC - **	40	Mar. 73	202,452	23,350	
A. W. Beattie - **	834	June 73	2,175,600	210,818	110,339
Upper Bucks Co. - **	496	Sept. 72	3,328,000	412,360	
TOTAL 1964-1973	55,220		$263,790,801	$35,432,593	$17,620,892

* New Building
** Expansion

APPENDIX B

SEMANTIC DIFFERENTIAL

INSTRUCTION FOR COMPLETION OF
AREA VOCATIONAL-TECHNICAL SCHOOL EVALUATION SURVEY FORM

The purpose of this study is to obtain your concept of certain items in vocational education and related academic programs. In completing this survey form, please make your judgments on the basis of what these things mean to you. On each page of this survey form you will find different items to be judged and beneath it a set of scales. You are to place one check mark along each scale to indicate your concept of the item.

HERE IS HOW YOU ARE TO USE THESE SCALES, PLEASE REFER TO THE FIRST ITEM (SHOP TEACHER) AND SET OF SCALES:

If your concept of shop teacher is very closely related to one end of the scale, you might place your check marks as follows:

NEUTRAL

fast __X__ : ____ : ____ : ____ : ____ : ____ : ____ slow

tense ____ : ____ : ____ : ____ : ____ : ____ : __X__ relaxed

If your concept of shop teacher is quite closely related to one or the other end of the scale (but not extremely), you might place your check marks as follows:

NEUTRAL

fast ____ : __X__ : ____ : ____ : ____ : ____ : ____ slow

tense ____ : ____ : ____ : ____ : ____ : __X__ : ____ relaxed

If your concept of shop teacher seems only slightly related to one side as opposed to the other side (but is not really neutral), then you might place your check marks as follows:

NEUTRAL

fast ____ : ____ : __X__ : ____ : ____ : ____ : ____ slow

tense ____ : ____ : ____ : ____ : __X__ : ____ : ____ relaxed

The direction toward which you check, of course, depends upon which of the two ends of the scale seems most characteristic of the item you're judging. If you consider your concept of shop teacher to be neutral on the scale, both sides of the scale equally associated with your concept of shop teacher, or if the scale is completely irrelevant, unrelated to your concept of shop teacher, then you should place your check marks in the neutral space as follows:

NEUTRAL

fast ____ : ____ : ____ : __X__ : ____ : ____ : ____ slow

tense ____ : ____ : ____ : __X__ : ____ : ____ : ____ relaxed

IMPORTANT (1) Place your check marks in the middle of the spaces, not on the boundaries:

THIS NOT THIS

____ : ____ : __X__ : ____ : ____ : ____X____

(2) Be sure you check every scale for your concept of the item--<u>do not omit any</u>. Notice that there are either seven or nine scales for each item.

(3) Never put more than one check mark on a single scale.

Sometimes you may feel as though you've had the same item before on the survey. This will not be the case, so do not look back and forth through the survey form. Do not try to remember how you checked similar items earlier in the survey. Provide a separate and independent judgment for each item. Work at a fairly high speed throughout this survey form. Do not worry or puzzle over individual items. It is your first impression, the immediate "feeling" about the item, that is important. On the other hand, please do not be careless, because we want your true impressions.

ITEM

SHOP TEACHER

		neutral						
(1) FAST	____	____	____	____	____	____	____	SLOW
(2) TENSE	____	____	____	____	____	____	____	RELAXED
(3) INTERESTING	____	____	____	____	____	____	____	BORING
(4) POSITIVE	____	____	____	____	____	____	____	NEGATIVE
(5) UNHELPFUL	____	____	____	____	____	____	____	HELPFUL
(6) PLEASANT	____	____	____	____	____	____	____	UNPLEASANT
(7) EASY	____	____	____	____	____	____	____	DIFFICULT

SHOP COURSE

		neutral						
(1) FAST	____	____	____	____	____	____	____	SLOW
(2) TENSE	____	____	____	____	____	____	____	RELAXED
(3) BAD	____	____	____	____	____	____	____	GOOD
(4) INTERESTING	____	____	____	____	____	____	____	BORING
(5) POSITIVE	____	____	____	____	____	____	____	NEGATIVE
(6) UNHELPFUL	____	____	____	____	____	____	____	HELPFUL
(7) PLEASANT	____	____	____	____	____	____	____	UNPLEASANT
(8) EASY	____	____	____	____	____	____	____	DIFFICULT
(9) USEFUL	____	____	____	____	____	____	____	USELESS

NAME OF YOUR SHOP COURSE _____

ENGLISH TEACHER

		neutral						
(1) FAST	____	: ____	: ____	: ____	: ____	: ____	: ____	SLOW
(2) TENSE	____	: ____	: ____	: ____	: ____	: ____	: ____	RELAXED
(3) INTERESTING	____	: ____	: ____	: ____	: ____	: ____	: ____	BORING
(4) POSITIVE	____	: ____	: ____	: ____	: ____	: ____	: ____	NEGATIVE
(5) UNHELPFUL	____	: ____	: ____	: ____	: ____	: ____	: ____	HELPFUL
(6) PLEASANT	____	: ____	: ____	: ____	: ____	: ____	: ____	UNPLEASANT
(7) EASY	____	: ____	: ____	: ____	: ____	: ____	: ____	DIFFICULT

ENGLISH

		neutral						
(1) FAST	____	: ____	: ____	: ____	: ____	: ____	: ____	SLOW
(2) TENSE	____	: ____	: ____	: ____	: ____	: ____	: ____	RELAXED
(3) BAD	____	: ____	: ____	: ____	: ____	: ____	: ____	GOOD
(4) INTERESTING	____	: ____	: ____	: ____	: ____	: ____	: ____	BORING
(5) POSITIVE	____	: ____	: ____	: ____	: ____	: ____	: ____	NEGATIVE
(6) UNHELPFUL	____	: ____	: ____	: ____	: ____	: ____	: ____	HELPFUL
(7) PLEASANT	____	: ____	: ____	: ____	: ____	: ____	: ____	UNPLEASANT
(8) EASY	____	: ____	: ____	: ____	: ____	: ____	: ____	DIFFICULT
(9) USEFUL	____	: ____	: ____	: ____	: ____	: ____	: ____	USELESS

MATH TEACHER

		neutral						
(1) FAST	____	____	____	____	____	____	____	SLOW
(2) TENSE	____	____	____	____	____	____	____	RELAXED
(3) INTERESTING	____	____	____	____	____	____	____	BORING
(4) POSITIVE	____	____	____	____	____	____	____	NEGATIVE
(5) UNHELPFUL	____	____	____	____	____	____	____	HELPFUL
(6) PLEASANT	____	____	____	____	____	____	____	UNPLEASANT
(7) EASY	____	____	____	____	____	____	____	DIFFICULT

MATHEMATICS

		neutral						
(1) FAST	____	____	____	____	____	____	____	SLOW
(2) TENSE	____	____	____	____	____	____	____	RELAXED
(3) BAD	____	____	____	____	____	____	____	GOOD
(4) INTERESTING	____	____	____	____	____	____	____	BORING
(5) POSITIVE	____	____	____	____	____	____	____	NEGATIVE
(6) UNHELPFUL	____	____	____	____	____	____	____	HELPFUL
(7) PLEASANT	____	____	____	____	____	____	____	UNPLEASANT
(8) EASY	____	____	____	____	____	____	____	DIFFICULT
(9) USEFUL	____	____	____	____	____	____	____	USELESS

YOUR CLASS SCHEDULE

		neutral						
(1) FAST	____	____	____	____	____	____	____	SLOW
(2) TENSE	____	____	____	____	____	____	____	RELAXED
(3) BAD	____	____	____	____	____	____	____	GOOD
(4) INTERESTING	____	____	____	____	____	____	____	BORING
(5) POSITIVE	____	____	____	____	____	____	____	NEGATIVE
(6) UNHELPFUL	____	____	____	____	____	____	____	HELPFUL
(7) PLEASANT	____	____	____	____	____	____	____	UNPLEASANT
(8) EASY	____	____	____	____	____	____	____	DIFFICULT
(9) USEFUL	____	____	____	____	____	____	____	USELESS

VO-TECH SCHOOL

		neutral						
(1) FAST	____	____	____	____	____	____	____	SLOW
(2) TENSE	____	____	____	____	____	____	____	RELAXED
(3) BAD	____	____	____	____	____	____	____	GOOD
(4) INTERESTING	____	____	____	____	____	____	____	BORING
(5) POSITIVE	____	____	____	____	____	____	____	NEGATIVE
(6) UNHELPFUL	____	____	____	____	____	____	____	HELPFUL
(7) PLEASANT	____	____	____	____	____	____	____	UNPLEASANT
(8) EASY	____	____	____	____	____	____	____	DIFFICULT
(9) USEFUL	____	____	____	____	____	____	____	USELESS

APPENDIX C

CORRESPONDENCE WITH RECOGNIZED AUTHORITIES IN VOCATIONAL-TECHNICAL EDUCATION

NATIONAL EDUCATION ASSOCIATION • 1201 16th St., N.W., Washington, D C 20036 • (202) 833-4000
MRS. CATHARINE BARRETT, President
SAM M. LAMBERT, Executive Secretary

May 16, 1973

Mr. D. B. Zucco
Administrative Assistant
Academic Affairs
Vocational Technical School
445 Schoolhouse Road
Johnstown, Pennsylvania 15904

Dear Mr. Zucco:

This will acknowledge your letter of May 9.

We have checked our files and various resources at hand, but did not locate any reports that relate specifically to levels of achievement of students in full-time vocational-technical schools as compared to students in part-time vocational-technical schools. Enclosed, however, are two articles on vocational-technical students which may be of general interest.

If you have not already done so, you may wish to check with the following:

Educational Resources Information Center
Clearinghouse on Vocational and Technical Education
Ohio State University
1900 Kenny Road
Columbus, Ohio 43210

Sincerely yours,

Glen Robinson

Glen Robinson
Director of Research

GR:Klb

Enclosures

EDUCATIONAL TESTING SERVICE PRINCETON, N.J. 08540

Area Code 609
921-9000
CABLE EDUCTESTSVC

Vocational-Technical
Education Projects

June 1, 1973

Mr. D. B. Zucco
Administrative Assistant
Academic Affairs
Greater Johnstown Area
Vocational Technical School
445 Schoolhouse Road
Johnstown, PA 15904

Dear Mr. Zucco:

In regard to your investigation of levels of achievement of students in full-time vocational-technical schools as compared to students in part-time vocational-technical schools, I suggest that you get in touch with Dr. Burr Coe, formerly Director of the Middlesex County Vocational School in New Brunswick, N.J. I think he may have data that would be relevant.

Best wishes.

Sincerely,

Benjamin Shimberg

Ben Shimberg, Director
Occupational Studies & Programs

BS/ld

WALTER M. ARNOLD ASSOCIATES, INC.
VOCATIONAL AND TECHNICAL EDUCATION CONSULTANTS
SUITE 522
1501 SOUTH SCOTT STREET
ARLINGTON, VIRGINIA 22204
(703) 920-2168 - 920-1111

May 18, 1973

Mr. D. B. Zucco
Administrative Assistant
Academic Affairs
Greater Johnstown Area Vocational
Technical School
445 Schoolhouse Road
Johnstown, Pennsylvania 15904

Dear Mr. Zucco:

In reply to your request of May 9, I would suggest that you communicate with the following:

Dr. Ben Shimberg
Educational Testing Service
Princeton, New Jersey

Mr. Joseph N. Snarponis
Director of Research
National Society of Professional Engineers
2029 "K" Street, N.W.
Washington, D.C. 20006

Dr. Robert Taylor
Ohio Center for Research in Vocational Education
Ohio State University
Columbus, Ohio

Dr. Shimberg has developed some proficiency tests which might be useful in your study. Mr. Snarponis has developed some achievement standards for certificating technicians. The Ohio Center may have research reports bearing on your topic.

Sincerely,

Walter M. Arnold (J.R.)

Walter M. Arnold
President

WMA:jar

INSTITUTE FOR THE CERTIFICATION OF ENGINEERING TECHNICIANS

sponsored by the National Society of Professional Engineers

202—659-5172

2029 K Street, N.W. / Washington, D.C. 20006

June 1, 1973

D. E. Zucco
Administrative Assistant
Academic Affairs
Greater Johnstown Area
Vocational Technical School
445 Schoolhouse Road
Johnstown, Pennsylvania 15904

Dear Mr. Zucco:

I have been conducting research in the area of academic achievement on and off for a number of years and must caution you about interactive effects of situational, personality, and educational factors. Anxiety, need for achievement, fear of failure, etc. are good starting points for your research. Also within and between subject matter areas, differential effects can be noted. Unless you consider these variables interpretation of results can be very difficult or even impossible.

A second problem is identifying a valid index of achievement. Grades have serious problems because they relate to the educational and employment process in varying degrees.

Sample selection is also a problem. If you use only one school, the results will have very limited applicability.

Another problem is the mix of courses; i.e., some courses will be contained in fall and part-time programs. If you can find entire schools that are either full or part time and not both, this might not be a problem.

The usual library research should be a starting point with Dissertation Abstracts being among the first resources you access.

When you are a bit further along, let me know if I can be of further assistance. Good luck!

Sincerely yours,

Joseph M. Snarponis
Executive Secretary

JMS/amh

92

THE CENTER FOR VOCATIONAL AND TECHNICAL EDUCATION

Phone (614) 486-3655

THE OHIO STATE UNIVERSITY
1960 KENNY ROAD
COLUMBUS, OHIO 43210

June 12, 1973

Mr. D. B. Zucco
Administrative Assistant
Academic Affairs
Vocational Technical School
445 Schoolhouse Rd.
Johnstown, Pennsylvania 15904

Dear Mr. Zucco:

Dr. Robert Taylor, Director of The Center for Vocational and Technical Education has asked me to respond to your letter of May 22.

My suggestion is that you search Research in Education (an ERIC publication) which is available in most college libraries. Search terms should be:

Area Vocational Schools
Vocational Schools
Vocational High Schools

I believe that a similar study was conducted by a doctoral student at the University of Missouri-Columbia. Dissertation Abstracts should contain a description of that study.

Sincerely,

David H. Miller

David H. Miller
Information Specialist
User Services

DHM:wb

Correspondence was received from the following authorities in vocational-technical education.

1. Dr. Walter M. Arnold
   President
   American Vocational Research Corporation
   1510 "H" Street, N.W.
   Washington, D.C.

2. Mr. Glen Robinson
   Director of Research
   National Education Association
   1201 16th Street, N.W.
   Washington, D.C. 20036

3. Mr. Ben Shimberg, Director
   Occupational Studies & Programs
   Educational Testing Service
   Princeton, New Jersey 08540

4. Dr. Joseph M. Snarponis
   Executive Secretary
   Institute For The Certification Of Engineering Technicians
   2029 K Street, N.W.
   Washington, D.C. 20006

5. Dr. Robert Taylor
   Director
   The Center For Vocational And Technical Education
   Ohio State University
   1960 Kenny Road
   Columbus, Ohio 43210

APPENDIX D

FUNDING AUTHORIZATION FROM THE RESEARCH COORDINATING UNIT FOR VOCATIONAL EDUCATION IN PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF EDUCATION
BOX 911, HARRISBURG, PA. 17126

February 6, 1974

Mr. Donald B. Zucco
Administrative Assistant
Greater Johnstown AVTS
445 Schoolhouse Road
Johnstown, PA 15904

Re: "A Comparison of Academic Achievement in Full-Time & Part-Time Area Vo-Tech High Schools"

The Research Coordinating Unit acknowledges receipt of the above proposal/prospectus submitted for vocational education funding as a research or exemplary activity. The proposal is now being reviewed by RCU and other PDE staff who will apply relevant criteria in evaluating your proposed activities.

During the review process you may be contacted to clarify certain points. In any event, you will be notified at once when a decision has been reached regarding the proposal/prospectus.

Sincerely,

Carroll A. Curtis

Carroll A. Curtis, Director
Research Coordinating Unit
for Vocational Education

CAC/dlr

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF EDUCATION
BOX 911, HARRISBURG, PA. 17126

April 15, 1974

Mr. Donald B. Zucco
Administrative Assistant
Greater Johnstown AVTS
445 Schoolhouse Road
Johnstown, PA 15904

Dear Mr. Zucco:

School Unit: 1-08-11-260-7 Project Number: 19-3030

Re: "A Comparison of Academic Achievement in Full-Time & Part-Time Area Vo-Tech High Schools"

We are well into the final quarter of the current fiscal year. In accordance with federal and state regulations, I wish to advise you of three important factors concerning the above project.

1. It is imperative that you expend the total amount of funds (federal) approved for your project on or before June 30, 1974. No invoices will be honored carrying a post June 30 date.

2. Any internal budget transfers should be processed through our office. The transfer requires a formal letter detailing the amounts and categories involved in the change. The reason for the change should also be stated in the letter. It is essential that all budget transfer letters be sent to our office before April 30, 1974.

3. As agreed upon in your acceptance of the project grant, you are required to submit an annual or final report. Five copies of the report should be submitted to the Research Coordinating Unit by August 1, 1974 or as soon thereafter as possible. Continuation projects are especially critical in the above matter.

Disregard the above items if you have made prior arrangements through PDE personnel regarding your specific project. Any questions should be directed to RCU personnel at the following address: Pennsylvania Department of Education, Research Coordinating Unit, Box 911, Harrisburg, Pennsylvania 17126, Telephone: (717) 787-4865.

Sincerely,

Carroll A. Curtis

Carroll A. Curtis, Director
Research Coordinating Unit
for Vocational Education

CAC/dlr

APPENDIX E

TRADE AND INDUSTRIAL SHOP AREAS IN THE FOUR SAMPLE SCHOOLS

TRADE AND INDUSTRIAL SHOP AREAS IN SAMPLE SCHOOLS FROM WHICH STUDENTS WERE INVOLVED IN STUDY

Small Full-Time AVTS

1 Auto Mechanics
2 Machine Shop
3 Cosmetology
4 Distributive Education

Small Part-Time AVTS

1 Auto Mechanics
2 Machine Shop
3 Cosmetology
4 Auto Body
5 Carpentry
6 Electric
7 Food Service
8 Heating, Ventilating, and Air Conditioning

Large Full-Time AVTS

1 Auto Mechanics
2 Machine Shop
3 Cosmetology
4 Auto Body
5 Building Maintenance
6 Carpentry
7 Electric
8 Food Service
9 Health Assistant
10 Heating, Ventilating, and Air Conditioning
11 Heavy Mine Mechanic
12 Metal Fabrication
13 Printing
14 Service Station Mechanic
15 Textiles
16 Trowel Trades
17 Welding

Large Part-Time AVTS

1 Auto Mechanics
2 Machine Shop
3 Auto Body
4 Building Maintenance
5 Carpentry
6 Diesel Mechanic
7 Food Service
8 Metal Fabrication
9 Plumbing
10 Refrigeration
11 Welding

APPENDIX F

SEMANTIC DIFFERENTIAL GROUP MEANS

FULL-TIME AVTS AND PART-TIME AVTS
CONCEPT OF SHOP TEACHER

Semantic Differential Concepts	Group Mean Scores Full-Time	Part-Time
Fast - Slow	0.6	1.4
Tense - Relaxed	0.8	1.5
Interesting - Boring	0.2	1.2
Positive - Negative	1.0	1.8
Unhelpful - Helpful	1.5	1.8
Pleasant - Unpleasant	0.9	1.7
Easy - Difficult	0.6	1.1

FULL-TIME AVTS AND PART-TIME AVTS
CONCEPT OF SHOP COURSE

Semantic Differential Concepts	Group Mean Scores Full-Time	Part-Time
Fast - Slow	0.9	1.5
Tense - Relaxed	1.3	1.7
Bad - Good	1.8	2.3
Interesting - Boring	1.4	2.0
Positive - Negative	1.6	2.1
Unhelpful - Helpful	2.2	2.3
Pleasant - Unpleasant	1.6	2.0
Easy - Difficult	1.0	1.1
Useful - Useless	2.2	2.6

FULL-TIME AVTS AND PART-TIME AVTS
CONCEPT OF ENGLISH TEACHER

Semantic Differential Concepts	Group Mean Scores Full-Time	Part-Time
Fast - Slow	0.8	0.0
Tense - Relaxed	0.9	0.4
Interesting - Boring	-0.1	-0.4
Positive - Negative	0.7	0.3
Unhelpful - Helpful	0.9	0.5
Pleasant - Unpleasant	0.7	0.5
Easy - Difficult	0.2	0.4

FULL-TIME AVTS AND PART-TIME AVTS
CONCEPT OF ENGLISH

Semantic Differential Concepts	Group Mean Scores Full-Time	Part-Time
Fast - Slow	0.5	-0.2
Tense - Relaxed	0.3	0.2
Bad - Good	0.4	-0.2
Interesting - Boring	-0.2	-0.8
Positive - Negative	0.4	-0.2
Unhelpful - Helpful	0.8	-0.2
Pleasant - Unpleasant	0.3	-0.3
Easy - Difficult	0.1	0.3
Useful - Useless	0.8	-0.2

FULL-TIME AVTS AND PART-TIME AVTS
CONCEPT OF MATH TEACHER

Semantic Differential Concepts	Group Mean Scores Full-Time	Part-Time
Fast - Slow	1.1	0.2
Tense - Relaxed	0.5	-0.1
Interesting - Boring	-0.1	-0.7
Positive - Negative	0.8	-0.2
Unhelpful - Helpful	1.3	0.3
Pleasant - Unpleasant	0.8	0.0
Easy - Difficult	0.3	0.0

FULL-TIME AVTS AND PART-TIME AVTS
CONCEPT OF MATHEMATICS

Semantic Differential Concepts	Group Mean Scores Full-Time	Part-Time
Fast - Slow	1.0	0.2
Tense - Relaxed	0.1	0.2
Bad - Good	0.9	0.0
Interesting - Boring	0.2	-0.4
Positive - Negative	0.7	0.2
Unhelpful - Helpful	1.4	0.6
Pleasant - Unpleasant	0.4	-0.2
Easy - Difficult	0.0	0.1
Useful - Useless	1.6	0.9

FULL-TIME AVTS AND PART-TIME AVTS
CONCEPT OF YOUR CLASS SCHEDULE

Seman[illegible]fferential [illegible]pts	Group Mean Scores	
	Full-Time	Part-Time
Fast - Slow	1.2	0.6
Tense - Relaxed	1.1	0.8
Bad - Good	1.4	0.6
Interesting - Boring	1.0	-0.1
Positive - Negative	1.3	0.4
Unhelpful - Helpful	1.5	0.4
Pleasant - Unpleasant	1.3	0.3
Easy - Difficult	1.3	0.7
Useful - Useless	1.6	0.3

FULL-TIME AVTS AND PART-TIME AVTS
CONCEPT OF VO-TECH

Semantic Differential Concepts	Group Mean Scores	
	Full-Time	Part-Time
Fast - Slow	1.7	1.7
Tense - Relaxed	1.7	1.6
Bad - Good	2.2	2.0
Interesting - Boring	2.0	1.9
Positive - Negative	2.0	1.9
Unhelpful - Helpful	2.2	2.2
Pleasant - Unpleasant	2.2	1.9
Easy - Difficult	1.8	1.4

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TITLE: CAREER EDUCATION IN SOUTH JERSEY: THE GLASSBORO-VINELAND PROJECT. A DESCRIPTION OF THE MARRIAGE OF A COLLEGE AND A SCHOOL DISTRICT AND ITS GROWING FAMILY.

DESCRIPTOR: *CAREER EDUCATION; *COLLEGE SCHOOL COOPERATION; *CURRICULUM DEVELOPMENT; *COCURRICULAR ACTIVITIES; *PROGRAM DEVELOPMENT

IDENTIFIER: NEW JERSEY

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 9P.

ABSTRACT: THIS REPORT DESCRIBES THE EFFORT TO IMPLEMENT CAREER EDUCATION IN THE VINELAND (NEW JERSEY) SCHOOL DISTRICT. AS A TEAM, VINELAND TEACHERS AND COUNSELORS AND GLASSBORO STATE COLLEGE FACULTY MEMBERS WORKED ON NEW LESSON PLANS AND COUNSELING ACTIVITIES. CURRICULAR AND EXTRACURRICULAR CONCERNS ARE DESCRIBED AND THE FUTURE OF THIS PROJECT IS DISCUSSED. (LJ)

INSTITUTION NAME: GLASSBORO STATE COLL., N.J.; VINELAND SCHOOL DISTRICT, N.J.

102 493

SEP 03 1975 /AS

CAREER EDUCATION IN SOUTH JERSEY: THE GLASSBORO-VINELAND PROJECT

A Description of the Marriage of a College and a School District and Its Growing Family

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April 1975

VT 102 493

CAREER EDUCATION IN SOUTH JERSEY: THE GLASSBORO-VINELAND PROJECT

A Description of the Marriage of a College and a School District and Its Growing Family

INTRODUCTION

Probably, most school districts have rid themselves of many of their misconceptions about career education; that is, they have discovered what it is not. For example, it is not simply vocational education renamed, nor occupational information in contemporary language. However, while career education cannot be equated with these and other programs and activities, it just as certainly includes them or has something significant and reforming to say about them. Therefore, by its conceptual nature, career education is both complex and comprehensive; it must deal with virtually all aspects of education simultaneously. It is indeed a whole which is greater than the sum of its parts.

Precisely because career education is such a concept rather than any specific program, it is devilishly and deviously difficult to implement, for to approach it piecemeal is to reduce it to less than it should be. On the other hand, it is unmanageable or impossible to do everything at once. Many steps that need to be taken require other steps to be taken first, owing to the complex and interdependent nature of educational systems. For example, the ultimate objective of career education may be said to be that every person develop the opportunities and abilities to choose wisely a balance and sequence of education and work experiences related to each other that result in a lifetime of both self-fulfillment and significant social contribution. But this goal presumes several things: a relationship between education and work, the availability of such opportunities to each individual throughout his or her lifetime, the conscious attitude of individuals that such choices are important, the ability of each individual to make such choices, etc. These things in turn depend on certain programs, activities, and conditions: parental knowledge and support, peer group encouragement, awareness of the range of work opportunities, exploration of these opportunities, skill preparation once choices are made, placement, continuing career development, cooperation of business and industry with education at all levels, articulation between educational levels, etc. In short, it is a battle on all fronts; everyone needs to be enlisted. Teachers, counselors, and administrators need re-education to help them change curriculum and school programs; parents and the general community need to be made aware of the need for their support and then need to lend that support, and cooperative arrangements must be established between schools and business and industry and then carried out.

It is in view of this very sweeping mission that the community of Vineland, New Jersey, with the assistance of Glassboro State College and the support and leadership of the State Department of Education, is embarked on a very comprehensive campaign to implement career education. It is an effort which is comprehensive in that it combines State direction and commitment, teacher education, community involvement, curriculum reform in all areas, extra-curricular programs and activities, and an integration of the local World of Work with students' school experiences.

CURRICULAR

What happens in the classroom obviously is the center of a student's school experience. To reform education in as fundamental a way as career education attempts to do, the classroom cannot be ignored. If career education is to have a significant impact, it cannot be simply an educational dessert; it is in fact a recipe for the appetizer and the entree as well as the dessert. The subject areas, as the meat and potatoes of school, must be cooked up in a new way.

Vineland turned to Glassboro State College for help on these aspects. The result is the Glassboro-Vineland Cooperative Curriculum Research Project federally-funded under Part C of the Vocational Education Act of 1963. Using this funding, Vineland teachers and counselors have been teamed up with Glassboro faculty from the same subject areas to work out the new lesson plans and counseling activities.

These teams met in the summer to rewrite entirely curriculum objectives and activities and to plan additional career education experiences for their students. The Vineland teachers and counselors did the actual writing; the Glassboro faculty acted as consultants and advisers. Group discussion together with intensive team workshop sessions served as a combination of teacher education and curriculum reform, two of career education's principle targets.

As a result of these individual and interactive sessions, the courses are entirely new. They do not include career education as merely separate and additional units, but rather incorporate career education and career development into the natural course of instruction. The teachers at the kindergarten through sixth grade levels are focusing on language skills and social studies with an eye to increasing their students' awareness of the World of Work. In the middle school, two teachers of Industrial Arts and two in Home Economics have accomplished a reconceptualization of that subject area in terms of career exploration and maturity. On the high school level, the Glassboro-Vineland teams are operating in the academic areas: Science, Math, English, Social Studies, and Health and Physical Education. In each of these areas, the teachers are helping students to develop the skills of that discipline and to discover the application of these skills in the World of Work.

The curricula and counseling plans that were developed during the summer are being implemented in both fall and spring terms using treatment and control groups. The teachers and counselors administer pre and post criterion-referenced tests (that they have constructed) to both treatment and control groups. In addition, the Glassboro Office of Career Education administers Crites' Career Maturity Inventory, pre and post, to both treatment and control groups. The Vineland staff continue to meet with the faculty members with whom they were teamed during the summer. They meet as a graduate class called "Practicum in Curriculum and Instruction." As a practicum, this course is flexible but it is perhaps even more reality-based than most other practicum courses. In effect, this cooperative teaming and graduate class work accomplishes several career education objectives by one school-college arrangement: teacher education, counselor education, and actual curriculum and counseling reform on a fundamental, day-to-day basis.

After the teachers and counselors have had a year of supervised experience

with their new materials and curricula and after data have been collected and interpreted by the Glassboro Office of Career Education, (including the results of the classroom criterion-referenced tests and of the Crites CMI), the teams will get together again next summer. In another series of intensive individual and group workshop sessions, they will discuss the new approach, the new materials, etc. and will revise them accordingly. At that point, the materials and curricula having been pilot-tested and revised, they will be disseminated throughout the Vineland system and will be made available to anyone else who is interested in them.

In addition to this major research, development, and dissemination project in the classroom, other ongoing classroom programs both reinforce and help to spread the understanding and adoption of career education throughout the Vineland School System. "Technology for Children" is an established feature in the two largest elementary schools, contributing to the development of career education on the elementary level. In like manner, in the two middle schools, a healthy "Introduction to Vocations" program cycle is a vital part of career education at that level. In addition, both of these schools will begin next year a program in career exploration, a block of days set aside specifically to help students in an appropriate way at that level with their career development. The high school offers a very comprehensive selection of areas for career preparation, in both academic and vocational areas, and supplements this variety via a cooperative program with the county vocational-technical school. Finally, the Career Education Office for Vineland, located in the high school, takes a very active leadership role in stimulating the growth of career education throughout the school system, through formal and informal discussions with school staff and community individuals and groups and through the active dissemination and circulation throughout the Vineland School System of career education materials in many media for daily use by teachers and counselors.

EXTRACURRICULAR

While the classroom may be the center of the school experience, it is not the whole of it. In fact, often it is not even the most important part of it. Outside the classroom, many things can happen both formally and informally, as well as tangibly and intangibly. Although many informal vectors, such as peer group influence, are outside the direct purview of career education, most aspects are not. But even peer group influence and other things that are hard to get at are likely to be modified by successful career education efforts, owing to the interdependence of such factors. At any rate, while career educators would be fools or megalomaniacs to expect to do everything, especially outside of the classroom and the counseling office, there is an indefinite number of areas in which career education can be put to work. Quite a few such efforts have begun in Vineland as briefly outlined below. Basically, these efforts have one common denominator: the opening of doors in the wall that has developed between schools and the community context in which they function; that is, the local World of Work. For purposes of this discussion, these efforts are divided into three categories: speakers programs, field trips, and placement.

Speakers Programs

At the beginning of the school year, all juniors and seniors were surveyed

on a very short form to identify their major areas of career interest. The shortness of the form encouraged positive response to it, made it easier to tabulate, and did not require students to be overly specific. On the basis of the results obtained on this form, speakers have been scheduled at a rate of 1 1/2 per week. When a speaker is scheduled, the data on the survey forms is massaged to produce a list of students who are interested in the area(s) represented by the speaker, and only those identified students are invited to hear him/her. The response to this program in general and to the speakers in particular has been very encouraging.

In other schools, speakers are also employed but not as systematically or regularly as at the high school. However, such examples are by no means rare, especially since the Vineland Career Education Office makes its services in arranging speakers very available and convenient. This system works because of the contacts and relationships the Office has developed as a result of the high school program. Finally, we have discovered that individual teachers are with increasing frequency arranging outside speakers for individual classes, either on their own or with the help of the Career Education Office.

Field Trips

While invited speakers, often with display and simulation materials, films and other speaking aids, have been extremely effective, some verisimilitude is lost because students at those programs still find themselves in the school. Taking them where the action is adds a strong dose of reality to their encounters with specific careers. To experience for themselves the working environment, to witness the actual operations and behaviors of people in that environment, and to talk with a variety of those people is obviously more effective than hearing someone describe these things or seeing them represented indirectly. Therefore, the Vineland Career Education Office has undertaken an ambitious field trip program, despite the difficulties occasioned by the energy crisis and other economically inhibiting factors.

Such field trips have been sponsored at all levels, but especially at the high school level. Again using the data from the survey forms at the high school, but also using teachers' and counselors' more direct knowledge of students' interests, field trips have been taken to colleges, to business and industry locations, and to military installations. In the cases of colleges and military installations, such trips not only present these two institutions as career options, but in addition colleges are a source of information about, and examples of, careers as represented in their curricula, and the military is a cornucopia of careers in which servicemen are engaged as the focus of their military service. In this regard, the State Department and the College have been very helpful to the Vineland staff because the number of contacts for possible field trips is expanded through the cooperation of people working in those two agencies. In fact, there have been two field trips to Glassboro State College itself, one by two elementary classes and one by an extra-curricular high school group, not to see the College per se, but rather to explore specific career clusters.

Placement

The full-time job placement coordinator in the Vineland Career Education

Office has partial responsibility for the speakers and field trip programs, as well as major responsibility for placement. This overlap is important and effective because the relationships established in each program between the coordinator and local business people always have the potential of becoming relationships for the other programs. It is testimony to the effectiveness of this aspect of the total career education effort that by March, 185 students had been placed in part-time employment despite a staggering County unemployment rate that recently topped 16 per cent. It is clear that the placement effort owes some of its success to the growing reputation of Vineland career education efforts in general.

To this point, the placement program has operated for juniors and seniors during the school term. The coordinator keeps an active file of both jobs and students so that either can be the initiating step or stimulus to a specific placement effort. However, students are not placed by the coordinator; they are referred. In this way, students get a sample of what it's like to apply for a job as well as to do one. Students are asked to return to discuss with the coordinator how the interview went, and if placement occurs, to discuss any on-the-job or post-job questions or problems. Building on this arrangement we hope to begin next year an effort for post-graduation placement and follow-through.

World of Work

We should not leave this section without mentioning a nascent, but rapidly developing and expanding relationship. The Vineland Chamber of Commerce has taken a major leadership role in helping to build the bridge from education to the Vineland business community. The arrangements the Chamber is making have positive implications for all aspects of the career education effort.

The Chamber has compiled an extensive list of Vineland businesses and businessmen who are willing (a) to speak or provide speakers to specific classes or groups, (b) to host visits from classes or school groups to the business site, and/or (c) to allow individual students to be placed in the work setting for one to three days.

A series of speakers or field trips, from the same or different businesses, can now be scheduled easily through the Chamber, lending greater flexibility to the program. It is conceivable now that with a single phone call, arrangements can be made for a class to be exposed not just to one occupation but to an entire cluster in a coherent, sequential way. This sequential exposure can occur either via speakers or via field trips, or via a combination of the two. This arrangement makes it easier and more appealing for businesses and industry to volunteer their cooperation, and it expands enormously the breadth and depth of such programs, all the while making them administratively simple. It encourages classroom teachers to utilize outside speakers and field trips more freely and systematically; they can plan curriculum and lessons on the safe assumption that certain speakers and field trips are available.

The arrangements made through the Chamber make an interesting twist in the placement concept. Individual students, either identified by teachers or on

their own, can apply to the Career Education Office not only for placement in part-time, paid employment as discussed above, but also for placement for one to three days of non-paying career investigation. By this arrangement, the student on his or her own time visits a volunteering business in the area of his/her interest to witness and examine that business at length and in depth with individualized attention. This sort of experience obviously is not possible on a field trip or even in a part-time job. While it is more valuable in principle, the value of this program diminishes the less clearly defined a student's career interests are and the less economically the volunteering business's time is used.

Recently, Cumberland County College has offered its cooperation and assistance. As discussed above in general terms, the College is itself a post-secondary option, but also it represents in its curricula many career fields. In this particular case, the County College is in many ways related to existing local and regional business and industry, providing the advantages of familiarity to students and to local employment possibilities. The greatest benefits of this new team member, of course, are the added variety of career exposures and options, and the growth of understanding of and cooperation with the career education effort throughout the County.

Glassboro Supports

Of course, one way in which Glassboro State College plays an essential role that has been described is the provision of faculty consultants in teachers' subject areas to help them revise their curricula. In addition, the Glassboro Office of Career Education provides a significant part of the administrative direction and support of the project, by its contact and consultation with the participating Glassboro faculty members, and by the use of a broadly representative Career Education Advisory Committee. Additionally, the assessment and evaluation activities in Vineland are supervised and coordinated by the Glassboro Career Education Office, primarily by the Research Specialist, a full-time professional career education researcher.

But the primary importance of Glassboro extends to South Jersey in general. Building on the foundation of experience in Vineland, the Office of Career Education helps to spread the infusion of career education into pre-service courses and activities, following the wisdom of the old bromide, "An ounce of prevention is worth a pound of cure." While the Vineland project is a seminal effort, obviously there are two many districts in South Jersey alone to work career education into them by funding each of them individually, Therefore, Glassboro's long-time service role as the primary in-service agent for South Jersey schools assumes renewed importance and centrality. Through supplemental State funding, Glassboro State College for four semesters has been offering graduate extension courses emphasizing the integration of career education into areas like Elementary Education, Special Education, etc. So far more than 1400 practicing educators in South Jersey, including teachers, counselors, and administrators, have taken one or more of these special courses, all of which are oriented to the practitioner and offered conveniently at the public school sites of these educators throughout South Jersey. In this way, the ideas and materials developed in Vineland are often valuable input and examples in the courses so the wheel is not repeatedly re-invented; and also, the activities and

the commitment in Vineland are reinforced and spread throughout the Vineland School System since a healthy number of the courses is offered in Vineland itself. Through the development of pre-service career education components and courses, and through the geographically broad provision of in-service graduate extension courses, Glassboro is helping to spread career education ideas and to stimulate the adoption and implementation of career education programs and curricula throughout South Jersey.

THE FUTURE

This paper began by saying that not everything can be done at once. Therefore, even though we have made an extremely good start, we must take an honest look in perspective to see what must yet be done. Using federal funding for the year 75-76, we will be developing curricula and supporting activities in Vineland in those specific subject areas and for specific populations, such as disadvantaged, bilingual, and handicapped, that have been somewhat neglected in the past. The result will be pilot-tested materials in all subject areas, distributed throughout the K-12 spectrum. However, apart from this specific gap-filling there are three more general aspects which will demand our attention in the future. These three areas of concern, it should be noted, are not unique to Vineland; they will be national priorities. While the State Department has been significant in administrative, consulting, and generally supporting ways in the project to this point, it will need to be even more instrumental in the future in addressing, and helping all school districts to solve, these larger issues. The State Department is in a position to apply the lessons learned in Vineland throughout the State.

First, we will need to make certain that we make as good use of our experience in Vineland as possible. If career education is successful as the reform movement which it is, then it must have a lasting effect; it must not become simply a funded project which dies when federal funding runs out. It must move from project to program to become an integral and ongoing component of every school district's activities. One thing this implies is the wide dissemination and adoption of the materials developed in Vineland sample classrooms not only throughout the Vineland system but also throughout all South Jersey School Districts. Glassboro and other colleges, as well as the State Department of Education, must redouble their efforts as service-oriented educational agents. Second, we must systematically look at the question of articulation, both between grade levels, among schools, and between public school, trade schools, community colleges, four year colleges, and continuing education. The State will have a key role in helping to insure that each step in each person's career development is related to the next step, but also implicit here are good working relationships both formal and informal between all of the State's institutions.

The third area is a logical extension of the second, and that is articulation between schooling and working. This is normally referred to as placement and follow-up or follow-through. There are two considerations here: (1) to make more systematic, dynamic, and helpful the synergism of "Coop programs" and programs like the "tag- along" or "shadow" option, and (2) to continue to check our schooling efforts against the reality of how our students actually perform in jobs and how they feel about those jobs, and revise our efforts and programs accordingly.

Admittedly, career education is a David in confrontation with Goliath. Like David, it can be successful; but also like David, it must continue to grow in wisdom and leadership. We have made a good start to put our house in order, but housekeeping must be a continuing activity. Career education is a concept, a philosophy, not a specific program. In light of that, we must continue to examine and reform what we are doing in line with that philosophy. We are helping students to prepare for careers and to adapt and adjust to a changing world. Career education reminds us that schools are not separate from that world but rather an integral part of it. Hence, we ourselves must continually re-examine, adjust, and grow just as we help students to do.

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PUBLICATION DATE: JUL74

TITLE: ALL OHIO VOCATIONAL YOUTH CAMP.

PERSONAL AUTHOR: REED, KAREN

DESCRIPTOR: *YOUTH LEADERS; *SUMMER WORKSHOPS; *VOCATIONAL EDUCATION; STUDENT LEADERSHIP; LEADERSHIP TRAINING; *STUDENT ORGANIZATIONS

IDENTIFIER: FUTURE FARMERS OF AMERICA; FFA; OHIO

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 6P.

ABSTRACT: A WORKSHOP FOR 212 SELECTED VOCATIONAL EDUCATION STUDENTS IN OHIO WAS HELD IN JULY 1974, AT CAMP MUSKINGUM WITH PROVISIONS FOR EDUCATIONAL SESSIONS, LARGE AND SMALL GROUP DISCUSSIONS, AND RECREATION AND SOCIAL PARTICIPATION. THE WORKSHOP ACTIVITIES WERE PLANNED AND CONDUCTED BY THE STUDENTS. EACH PARTICIPANT, THROUGH THE USE OF VARIOUS TECHNIQUES, WAS ENCOURAGED TO INVOLVE MEMBERS OF THEIR LOCAL SCHOOLS AND COMMUNITIES IN CRITICAL THINKING AND LEADERSHIP DEVELOPMENT. EVALUATIONS WERE MADE BY THE 10 MEMBERS OF THE YOUTH STAFF, 12 COUNSELORS AND 212 PARTICIPANTS AS TO THE EXTENT OF YOUTH INVOLVEMENT IN THE CAMP, AND A FOLLOWUP WAS CONDUCTED IN THE SPRING OF 1975. (NJ)

INSTITUTION NAME: OHIO FFA CAMP MUSKINGUM, INC., CARROLLTON.

SPONSORING AGENCY NAME: OHIO STATE DEPT. OF EDUCATION, COLUMBUS. DIV. OF VOCATIONAL EDUCATION.

102 507

TITLE OF PROGRAM OR PROJECT:	All Ohio Vocational Youth Camp Project Number R-7-75
APPLICANT ORGANIZATION:	Ohio FFA Camp Muskingum, Inc. R.R. #1, Carrollton, Ohio
INITIATOR: (Principal Investigator)	Karen Reed Camp Director Ohio FFA Camp Muskingum, Inc. R.R. #1, Carrollton, Ohio
PROJECT DIRECTOR: (If different from initiator)	Karen Reed Camp Director Ohio FFA Camp Muskingum, Inc. R.R. #1, Carrollton, Ohio
TRANSMITTED BY:	Karen Reed Camp Director Ohio FFA Camp Muskingum, Inc. 216-627-2208
DURATION OF ACTIVITY:	July 26, 1974 - July 29, 1974
PURPOSE OF GRANT OR CONTRACT:	Research and Training
USE OF FUNDS:	Research and Training Program
TOTAL FUNDS USED	10,145.60

VT 102 507

ABSTRACT

Title - All Ohio Vocational Youth Camp

Principal Investigator - Karen Reed, Camp Director

Total Funds Used - $10,145.60

Duration of Activity - July 26-29 (Actual Camp dates)

Some youth today have negative and uncooperative attitudes, others lack some leadership qualities and the ability to critically think through problems and make decisions as to what they really believe.

Through the All Ohio Vocational Youth Camp, a workshop for 212 selected vocational education students in Ohio, youth assumed responsibilities in planning and carrying out the workshop; they determined issues and concerns of youth today and reacted to resource persons' presentations and critically evaluated all that was said; each participant, through the use of various techniques, was encouraged to involve others in critical thinking and leadership development at their home school or community, and a cooperative spirit was developed among the vocational youth organizations.

The workshop was held at Camp Muskingum with provisions for educational sessions, small and large group discussions, recreation and social participation.

Evaluations were made by the 10 youth staff, 12 counselors and 212 participants as to the extent of youth involvement in the camp and a follow-up was conducted in the spring of 1975 to determine the extent the workshop participants and involved others in the critical thinking and leadership development techniques.

Title.....ALL OHIO VOCATIONAL YOUTH CAMP

A vocational education youth organization workshop for leadership, critical thinking, citizenship and personal development.

Applicant Organizations.....DECA, FFA, FHA, OEA and VICA

Initiator:_____
Adel Riegel, FHA State Advisor (614-466-3046)

Project Director:_____
Karen Reed, Camp Director, (614-467-6554)

Duration of Activity July 26-July 29 - Actual Camp Dates

Statement of Project Intent: Provide opportunities for 212 vocational youth, selected by the five vocational youth organizations, to gain skills in leadership and critical thinking; understandings of citizenship; growth in their own personal development; and knowledge of techniques for involving others in these same areas back in their home schools and communities.

Total Funds Used.....$10,145.60

PROPOSAL PLAN

Problem:

Much is being written and said about our youth of today. While there are many excellent student attitudes and actions noted, there are, of course many improvements needed. Some of our young people have negative and uncooperative attitudes and lack a desire for high achievement. It sometimes seems our youth are not as patriotic as would be desirable.

While this description of our youth may seem somewhat harsh, it is certain to have a degree of validity. Our youth in Vocational Education may, however, have an advantage. The fact that they know what they want to do for a life career, believe that work is honorable and respectable, and have started to develop their leadership and personal traits indicates they are heading in the right direction.

It seems appropriate to further develop in our young people in Vocational Education those desirable personal attitudes and qualities that are important to their personal development and to the future of our nation.

Objectives:

The objectives of this workshop were:

1. to allow youth to assume responsibilities in planning and carrying the leadership workshop.

2. to determine issues and concerns of youth today and present resource persons concerned with these issues as speakers for youth debate and question.

3. to provide each participant with techniques and ideas for involving fellow students at the home school and in the community in leadership development and critical thinking of issues of concern to them.

4. to foster a cooperative spirit among the vocational youth organizations.

Workshop Description

The 1974 All Ohio Vocational Youth Camp, a workshop on leadership, critical thinking, citizenship and personal development, was held July 26-29, 1974, at Ohio FFA Camp Muskingum, Carrollton, Ohio. Fifty participants were invited from each Vocational Youth Organization in Ohio and each organization determined their method of selection.

A 10-member youth council consisting of two officers from each Vocational Youth organization developed the program based on student concerns and issues. This youth council was advised by a workshop director in cooperation with the state youth leaders of each organization.

Twelve teachers selected from the five services were official camp counselors. They were responsible for working with selected campers or youth council members on various recreational and program activities. They reported to the workshop director who in turn reported to the five state youth leaders.

Resource persons with expertise in the field of the various youth concerns were responsible for handling the discussion topics. Student interest and participation were kept in mind in selecting these resource persons.

Youth workshop participants were provided with opportunities to discuss the various topics, through small and large group discussions. Youth participation also came through the various recreational activities, responsibilities at meal time and camp clean-up. Campers were also expected to involve others in the leadership and critical thinking techniques back in their home situations.

The camp/workshop program was structured to give a well-balanced program of educational sessions, recreation, and free time. The schedule was:

7:00 a.m. - Rise
7:30 a.m. - Breakfast
8:00 a.m. - Clean-up
9:00 a.m. - Discussion topics
11:00 a.m. - Recreation
12:00 noon - Lunch
1:00 p.m. - Discussion topics
3:00 p.m. - Recreation
5:30 p.m. - Dinner
6:15 p.m. - Recreation
8:30 p.m. - Discussion topics
10:00 p.m. - Campfire
12:00 a.m. - Lights out

Camp Muskingum regulations were observed.

Some examples are:

(1) Roll call of members was made at each small group session, and at bedside (12:00 midnight) to assure all campers were in attendance and safe and sound.

(2) All camp safety regulations and procedures were strictly adhered to.

(3) Smoking was confined to a designated safe area (lower level porch of assembly hall).

(4) Dormitories were monitored to make sure they were used only for sleeping or changing clothing.

(5) Respect and proper use of all buildings, equipment, and grounds was expected of all persons using Camp Muskingum.

Objectives Achieved

An evaluation of the workshop was made by the 10 youth staff, counselors and participants as to the extent of youth involvement in the planning and carrying out of the workshop, the selection of issues and concerns, the effectiveness of the resource persons and general overall feelings of the workshop. A follow-up report was made in the spring of 1975 to determine the extent of the involvement the participants had encouraged in their home schools and communities relating to the development of leadership, critical thinking, and citizenship.

FUNDING

The workshop was provided by the division of Vocational Education, with the exception of the participants' transportation to and from the camp. The expenditures were as follows:

Camp Fee	212 campers @ 21.75 each	$4,611.00
Camp Fee	12 counselors @21.75 each	261.00
Camp Fee	10 youth leaders @ 21.75 each	217.50
Camp Fee	Workshop Director & Resource persons	75.75
Workshop director		600.00
12 Counselors	Honorarium @ 200.00 each	2,400.00
6 Resource Persons	Honorarium @ 100.00 each	638.40
Office Supplies and Materials		440.40
Communications, postage, phone		28.17
Four Pre-Planning sessions and one post session evaluation with youth council (travel, lodging, meals, etc.)		448.38
Administration and Overhead		425.00
	TOTAL	$10,145.60

ACCESSION NUMBER: VT102508

PUBLICATION DATE: JUL75

TITLE: UTILIZATION OF COMMUNITY RESOURCES. FINAL REPORT.

PERSONAL AUTHOR: GOETZ, ALAN C.

DESCRIPTOR: *COMMUNITY RESOURCES; SUMMATIVE EVALUATION; *FILMS; *ELEMENTARY SECONDARY EDUCATION; *SCHOOL COMMUNITY COOPERATION; *CAREER EDUCATION; ELEMENTARY SCHOOL TEACHERS; SECONDARY SCHOOL TEACHERS

IDENTIFIER: MULTNOMAH COUNTY; OREGON

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 9P.

ABSTRACT: THE PURPOSE OF THE CAREER EDUCATION FILM PROJECT WAS TO DEVELOP AND PRESENT A 16 MILLIMETER MOTION PICTURE RELATING TO THE UTILIZATION OF COMMUNITY RESOURCES BY K-14 SCHOOL PERSONNEL AND FOR THE BENEFIT OF EMPLOYEES AND EMPLOYERS IN BUSINESS, INDUSTRY, AND GOVERNMENT. THE FINDINGS OF THE EVALUATION REPORT INDICATED THAT THE FILM, "TODAY'S COMMUNITY AND THE SCHOOLS," MET TWO OF ITS THREE PLANNED OBJECTIVES. THE SUCCESSFULLY COMPLETED OBJECTIVES INCLUDED INFORMING TEACHERS WHAT COMMUNITY RESOURCES WERE AVAILABLE AND WHEN THE UTILIZATION OF THESE RESOURCES WOULD BE MOST APPROPRIATE IN ACHIEVING EDUCATIONAL OBJECTIVES. NO PROGRESS WAS MADE IN ACHIEVING THE THIRD OBJECTIVE, A TEACHER-DEVELOPED PROGRAM ON HOW TO SECURE COMMUNITY RESOURCES, DUE TO THE UNAVAILABILITY OF FUNDS. (LJ)

INSTITUTION NAME: MULTNOMAH COUNTY INTERMEDIATE EDUCATION DISTRICT, PORTLAND, OREG.

SPONSORING AGENCY NAME: BUREAU OF OCCUPATIONAL AND ADULT EDUCATION (DHEW/OE), WASHINGTON, D.C.

102 50

FINAL REPORT

Project Number E-M-3-75

Grant Number

Alan C. Goetz
Multnomah County
Intermediate Education
District

Portland, Oregon

July, 1975

Oregon Department of Education
Career Program Development and Evaluation Unit

Applied Research

VT 102 508

ABSTRACT

Title: Utilization of Community Resources

Institution: Multnomah County Intermediate Education District

Project Director: Alan C. Goetz, Career Education Specialist

Address: Multnomah County Intermediate Education District
220 S.E. 102nd
P.O. Box 16657
Portland, Oregon 97233

Phone: 255-1841 Extension 188

Project Duration: July, 1974 to June, 1975

Cost:	Federal	Local	Total
	$4,000.00	$5,830.00	$9,830.00

Number of Students affected: all students in state K-14

Number of Staff affected: all teachers in state K-14

Project description: The goal of this project was to produce a film.

This film has three primary objectives:

1. To show what kinds of community resources are available.
2. To suggest some successful methods that have been employed when using a community resource.
3. Why the use of community resources is so important.

This film was developed for two primary audiences:

1. School personnel who use community resources.
2. Employees and employers in business, industry, and government.

BODY OF FINAL REPORT

A. Background (Description of Educational Setting)

One of the critical components of the overall Career Education concept is the extensive utilization of non-school resources. Planned programs for adding the massive resources of skilled personnel from community agencies, businesses, and industries, are integral parts of practically every successful career education program now operating in the United States.

Utilization of people, facilities, and materials available in the local area is, in truth, not a new thing to teachers in our metropolitan districts. Many, if not most, teachers have found valuable help available to them as they plan and organize learning activities for their students. Indeed, hundreds of students from area schools have gained greater skills, awareness of themselves, and experiences with the realities of the world of work through "on-site" involvement with governmental agencies, civic organizations, business firms, and local industries. The bulk of such efforts, however, have been carried out as individual efforts of teachers. It is these individual efforts on an ever increasing scale that have prompted action.

A comprehensive plan for utilizing community resources is being developed in the metro area. Efforts to systemize the multitude of resources and services available to teachers and students through the community are underway: Local businesses have formed the Institute for Public Affairs Research, Inc. (IPAR).

The existence of IPAR is a potential "gold mine" for teachers at all grade levels. This organization, which is supported entirely by contributions of local businesses and industries, is in the process of expanding an already impressive resource bank to supplement career awareness, career exploration, and work experience programs. However, IPAR's responsibility ends with identification and scheduling. It is education's responsibility to use these important resources to the limits of their potential.

The project presented in this proposal represents an important step in establishing more complete "linkages" between school personnel and the many educational resources available to them in the community.

Goals: The long-range aim of this project is to provide a single vehicle by which three goals can be achieved. They are:

1. Assist teachers in understanding when the utilization of a community resource is the most appropriate means of achieving an educational objective.

2. Assist teachers in recognizing what community resources are available.

3. Assist teachers in understanding how to use available community resources most effectively.

B. Major Accomplishment or Outcome

As the goal of this project was the production of a film, that goal has been reached. As to its effectiveness, that will be proven in time.

C. Evaluation

The following is the third party evaluation report as submitted.

CAREER EDUCATION FILM PROJECT

A. Nature of the Project

The overall purpose of the Career Education Film Project was to develop and present a 16mm motion picture relating to the utilization of community resources by school personnel. The film is designed to accomplish three general goals:

1. To enable teachers to recognize what community resources are available to them.

2. To enable teachers to recognize when utilization of community resources will add valuable dimensions to their classroom programs.

3. To enable teachers to understand how to secure and best utilize the resources available in and through the community.

B. Nature of Project Evaluation

The purpose of the project evaluation, as set forth in the project proposal, is to provide summative information regarding the accomplishment of the goals outlined above. Essentially, the evaluation strategy calls for determination of the extent of goal accomplishment by means of discrepancy comparisons. That is, project goals (intents) are compared with project accomplishments (outcomes). A discrepancy is identified whenever there is a lack of congruence between what is proposed and what is achieved. As a matter of reporting style, various activities toward the achievement of each goal will be discussed and a subjective judgement made as to whether the level of attainment has been:

1. excellent - implementation equal to or exceeding original expectations.

2. good - implementation just short of original expectations.

3. fair - implementation considerably short of original expectations.

4. poor - minimal or no implementation toward objective achievement.

5. undetermined - lack of evidence to support any reasonable judegment.

C. Evaulation Findings

Goal #1: A film will be produced which informs viewers (teachers) what community resources are available to them.

☒ excellent ☐ good ☐ fair ☐ poor ☐ undetermined

A 16mm sound film, Today's Community and the Schools, has been produced. Filmed in color, the film runs approximately 21 minutes and depicts typical community resources which may be utilized by teachers. Coverage includes:

1. field trip opportunities
2. job awareness counseling by workers
3. community speakers in the classroom
4. work experience and vocational training opportunities

In addition to the narration, which is mostly approached in a "matter-of-fact" manner, the sound track includes candid sections featuring informal comments by students, teachers, and members of the community, principally workers and employers. Obviously, not every resource available in the Tri-county metropolitan area could be included in the film, but the range of coverage reflects considerable advance planning in that it samples a very representative selection of typical resources available to teachers and students. (Transportation, banking, law enforcement, computer technology, mechanics, machine operation, food service, retail sales, and general merchandising, for example).

An important theme particularly well developed in the film relates to the changing nature of society - the continuing movement away from the rural, family/neighborhood "job selection" system and toward a more urban, diversified work world in which good vocational choices require a systematic program giving students vocational and occupation information and experience.

Goal #2: A film will be produced which informs viewers when utilization of community resources will add a valuable dimension to their classroom programs.

☒ excellent ☐ good ☐ fair ☐ poor ☐ undetermined

An important feature of Today's Community and the Schools is its use of local career education and work experience specialists and coordinators to describe sound procedures for 1) obtaining community resources, and 2) preparing for their most productive utilization. More than being merely a "helpful hints" rehash, the film shows ideal procedures in operation. The "reality" of the suggestions and advice is unquestionable since suggestions are coming directly from school personnel and community volunteers who, on a day-to-day basis, are actually doing the things they are recommending.

In summary, the film provides excellent guidelines for teachers in many areas: e.g., preparing students for coming field trips, pre-planning with guest classroom speakers, coordinating class

principles with on-site practices, and use of business and industrial personnel as "adjunct" instructors in career and vocational programs. Perhaps it's strongest point is its heavy use of practicing career/vocational education personnel as contributors both in the planning and "on camera".

Goal #3: A program will be developed by which teachers will learn how to secure community resources through a central coordinating office maintained by the project.

☐ excellent ☐ good ☐ fair ☐ poor ☒ undetermined

No progress has been made toward this goal since funds to develop and implement were eliminated when the project budget was negotiated. This goal will be pursued only when enabling funds are made available.

Summary

The film produced by this project, Today's Community and the Schools, is a first-rate production which obviously meets two of the three primary project objectives. (Non-attainment of the third objective cannot be seen as a responsibility of the project since supporting funds were not available).

The film reflects the producers' ability to do the same thing they advocate in their message - namely, to effectively utilize community resources, in this case teachers, students, local businessmen and workers in a variety of positions. Used as an entry-level guide rather than a procedural absolute, the film should be very useful in helping teachers become more aware of the resources available to them and the most effective way to use them in improving learning programs for students.

Ralph T. Nelsen, Ed.D.
Project Evaluator
January 25, 1975

TITLE OF PROJECT _____

	TOTAL COSTS	LOCAL COSTS	FEDERAL COSTS
A. Personnel-Including Employee Benefits			
1) Staff-List Names			
Cameraman/Producer: Gary Adams	$2,000.00	$2,000.00	
Secretary: Denise Bouchard	100.00	100.00	
2) Consultants-List Names			
Alan C. Goetz			
Sonya McDowell			
B. Travel at $.11 per mile	$250.00	$250.00	
C. Services--Please Specify			
Evaluation: Ralph Nelson	$200.00	$200.00	
D. Supplies			
Production costs @$400 per minute for 21 minutes.	$8,800.00	$5,000.00	$5,000.00
E. Equipment-Use only when approprite			
F. Other Costs			
Administration overhead @6%	$330.00	$330.00	
Postage, telephone, duplication, etc	150.00	150.00	
Cost Sharing (percent)	100%	60%	40%
Colum Totals	$9,830.00	$5,830.00	$4,000.00

Summary and Conclusions

Having been through my first film production, I am reminded of Murphy's Law.

Murphy's Law: If anything can go wrong, it will.

My own corallary: Murphy was an optimist.

ACG/db
7/25/75

ACCESSION NUMBER: VT102509

PUBLICATION DATE: 75

TITLE: DEVELOPMENT OF OCCUPATIONAL CONCEPTS FOR EDUCATIONAL PROGRAMS IN GRADES 11 AND 12.

PERSONAL AUTHOR: WELLMAN, FLORENCE M.

DESCRIPTOR: *GRADE 11; *GRADE 12; *CAREER CHOICE; *STUDENT NEEDS; *INSTRUCTIONAL IMPROVEMENT; SENIOR HIGH SCHOOLS; STUDENT DEVELOPED MATERIALS; SCHOOL COMMUNITY COOPERATION

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 8P.

ABSTRACT: COVERING THE TIME PERIOD FROM AUGUST 1974 TO JUNE 1975, THIS DOCUMENT REPORTS EXPERIENCES FURNISHED TO JUNIOR AND SENIOR HIGH SCHOOL STUDENTS OF WYOMING CITY SCHOOLS WHICH PROVIDED INFORMATION ON POSTSECONDARY EDUCATION AND CAREERS. ONE ASPECT OF THE PROJECT WAS TO ALLOW SENIORS TO PURSUE SUPPLEMENTARY LEARNING EXPERIENCES WITHIN THE COMMUNITY. OTHER ACTIVITIES INCLUDED WRITING CURRICULUM MATERIALS AND RESEARCHING CAREERS. EVALUATION WAS ACCOMPLISHED BY DAILY CONTACT WITH THE STUDENTS. (LJ)

INSTITUTION NAME: WYOMING CITY SCHOOLS, OHIO.

SPONSORING AGENCY NAME: OHIO STATE DEPT. OF EDUCATION, COLUMBUS.

102 509

Title of Program or Project:	Development of Occupational Concepts for Educational Programs in Grades 11 and 12 R-4-75
Applicant Organization:	Board of Education Wyoming City Schools
Initiator:	Dr. M. Herman Sims Assistant Superintendent Wyoming City Schools 513-761-7857
Project Director:	Mrs. Florence M. Wellman Career Development Coordinator Wyoming City Schools 513-761-7857
Transmitted by:	Mr. Harold Bush, Superintendent Wyoming City Schools 513-761-7857
Duration of Activity:	August 5, 1974 through June 13, 1975
Purpose of Grant or Contract:	To explore and to develop occupational concepts for educational programs in grades 11 and 12
Use of Funds:	To explore career areas and to coordinate appropriate activities for effecting meaningful attitudinal conceptualization on the part of parents, counselors, and educators in guiding career choices of students
Total Funds Expended:	$14,461.28

VT 102 509

ABSTRACT

Title of Research Program or Project:	Development of Occupational Concepts for Educational Programs in Grades 11 and 12
Principal Investigator:	Mrs. Florence M. Wellman
Contracting Agency:	Board of Education Wyoming City Schools
Amount of State Funds Expended:	$14,461.28
Beginning and Ending Dates:	August 5, 1974 through June 13, 1975

Problem

A need existed to provide educational experiences for juniors and seniors which would be meaningful and provide information for making decisions regarding post secondary plans. Therefore, we committed ourselves to the development of a program which would provide for the exploration of career areas for preprofessionals and the coordination of activities for effecting appropriate and realistic decisions regarding post secondary educational and career plans.

Statement of Objectives

1. To identify activities representative of the kinds of things students will be engaged in when they enter selected professions or careers
2. To research knowledge (facts, theories, principles, etc.) related to specific careers
3. To design a program arranging the activities and knowledge in a natural sequence or order as preparation for post secondary education

Activities

Activities involved selection of consultants available locally to help in the exploration of career areas, writing curricular materials relevant to project areas, researching careers, and engaging in specific career-related activities. The knowledge obtained and the activities engaged in were reported by the students and shared with the coordinator, administrators, parents, consultants, and director.

Evaluation

Evaluation was accomplished by daily contact of students with the coordinator and by periodic meetings of students, consultants, parents, and/or administrators, and through consultation with a university professor.

Contribution to Education

The development of an individualized educational program which provided a variety of meaningful experiences for students to help them to make wise and appropriate decisions regarding post secondary educational and career planning.

Our problem evolved around an awareness of the need to relate the total educational experience of each student to the real world with emphasis on the kind of knowledge and experiences which would help in making decisions relative to post secondary educational and career plans. As stated by Bruner, the first object of any act of learning is that it should serve the individual in the future. The need was recognized to develop a program to keep pace with a rapidly changing society by refocusing the content of instruction and relating it to real life situations and the developmental needs of youth. Realizing that there is no single right solution to career choice problems and that each individual must find the answer after considering a wide range of choices, a concerted effort was made to find existing curricular materials and to visit and observe similar programs in operation. Our ultimate purpose was to plan a program, through research, observation, and development of curricular materials, which would prepare the students academically, emotionally, and occupationally to help them in making decisions relative to post secondary educational and career plans.

The goals of our program were to provide students with informative, exploratory, and experiential activities in order to:

1. provide a continuity in the instructional program
2. create more effective techniques in the teaching/learning process
3. assist young people in making a wise career choice

Statistical data based on planning studies in which the district has been involved indicated a rather widespread awareness of a need for a more individualized preprofessional program of instruction. In 1970-71 a special study project, "A Critical Look at the High School by Former Students," was conducted by the Advisory Council for Vocational Education in Ohio under the direction of the Bureau of Educational Field Services of the School of Education, Miami University, Oxford, Ohio. Wyoming High School was selected as representative of the college preparatory high schools and was one of twelve schools participating in the statewide survey.

The reported statistics indicated a return of 30.5%. The school having the highest percentage of return was Wyoming with 61.8%; the range was from 5.8% to 61.8%.

In a summary statement on data compiled from responses received it was reported that:

1. One of the areas indicated by the graduates as being an area that "could be improved" in the high schools was "better correlation of high school training to actual situations in life and on the job" (18.6%).

2. Responses to questions pertaining to job and career orientation revealed "Nearly one of every two students (1142 - 44.6%)

indicated that there should have been more course offerings from which to select his personal program in order to better prepare for his work experience."

The ACT High School Profile Report for 1973-74 for the 157 students tested, out of a total of 198 students, indicated:

1. Among needs expressed for special help in college were "educational and vocational plans" (41%)

2. Expectation of working at a job during the school year and expressing need for help in finding a school-year job (41%)

3. Dissatisfaction with the emphasis on career education and planning--"Improvement needed" (26%), "pretty much neutral" (30%), "no experience" (11%), and "satisfied" (34%)

In a Phi Delta Kappan Educational Goals Study of Students and Faculty in 1973-74 reporting on three items relating to career education, out of 18 items surveyed, the variation in ratings of teachers and students on a 1 (high priority) to 18 (low priority) rating indicated:

1. Learn about and try to understand the changes that take place in the world - students, 5.5; faculty, 10.

2. Gain information needed to make job selections - students, 12; faculty, 15.

3. Develop skills to enter a specific field of work - students, 4; faculty, 16.

Some interesting implications for refocusing instructional materials and inservice of staff seem indicated in the differences in priority in these reported responses, e.g. Item 3.

A February, 1975 report of a subcommittee of the Citizens Advisory Committee which surveyed Wyoming High School graduates from 1968 through 1974, and representing a return of 26.8%, identified the following significant data:

1. Among responses to an open-ended question, "If you were to create the optimum learning environment, what improvements in courses, activities, scheduling, physical facilities, and general services would you suggest?" were "make courses more pertinent to life," and "need career help."

2. Among specific course offering suggestions were "communications," "job application and career skills," and more courses "related to life."

3. In answer to the questions, "What opportunities do you wish had been available to you in exploring career choices?" the summary reported by the committee stated, "The graduates mentioned many courses they wished they had been exposed to. It is as though they got to college and became aware of the many fields they

knew nothing about. They feel they don't have the background to make career choices."

Frequent suggestions for activities for career enlightenment were: career day, outside speakers who are active in their professions, field trips, a career day in each department, job opportunities information, and practical experience (teachers' aide, hospital volunteer).

The pattern of attendance at the joint vocational school was reflected in the following table:

Year	Students	Completing Graduating WHS	Returning WHS	Returning JVS	Other
71-72	2	2			
72-73	1	1			
73-74	2	1	1		
74-75	16	1	4 (OWE)	9	2

Programs elected by the students were in the areas of Secondary Instructional Aide, Cosmetology, Carpentry, Auto Collision, Air Conditioning, Horticulture, Child Care, Small Engine Repair, Tailoring, Data Processing, Welding-Metal Fabrication, Dental Assistant, Baking, and Commercial Electronics. As noted from the above breakdown of students attending vocational school in our district, they are electing programs which are not offered locally. The strong academic background provided at Wyoming High School, with 93% of the graduates going to college, explains to some extent why students would elect to remain in their home school. Therefore, since our professional commitment is to provide the best educational program for our students, our efforts were designed to develop an educational program which provided a continuity in the instructional program through creating more effective techniques in the teaching/learning process in order to assist young people to make wise career choices.

In the spring of 1974 a group of junior students proposed an alternative educational plan for their senior year. The students were encouraged to explore their idea and their research resulted in their submitting a proposal to the Board of Education for permission to pursue supplementary learning experiences within the greater Cincinnati community during their senior year. This request developed into the WHY (Wider Horizons for Youth) program. These students attended Wyoming High School for their required courses, American government, English, and in most cases, one other major. The rest of the student's day was spent in pursuit of outside interests under the direction of community resource persons. There was very close relationship among the students, coordinator, consultants, and program director in determining available resources, planning appropriate activities relating to the educational program, and evaluating the resultant effort. The coordinator had daily contact with the students. The coordinator was a member of a curriculum practicum under the leadership of the program director. A major part of the course work was research of existing career education programs and the determination of the kinds of materials and activities which could be adapted to the local situation. Our researching was accomplished through the review of materials developed by the Experience-Based Career Education programs sponsored by the National Institute of Education and through visitation of schools in Ohio.

The director of the program worked with a committee of interested lay persons to survey the community for persons interested in sharing their time and talent with the schools. As a result of this effort, a community resource handbook was compiled and distributed for use across the district.

The students explored many diverse areas including Animal Husbandry, Art, Ballet, Bio-Chemistry, Botany, Calligraphy, Carpentry, Ceramics, City Government, Creative Writing, Drawing, Ecology, Education, Etchings, Farm Management, Food Technology, French, Gardening, Government, Historical Research, Horticulture, Journalism, Law, Mechanics, Medical Biology, Music, Nutrition, Photography, Play Readings, Politics, Psychology, Public Relations, Publicity, Publishing, Sociology, Super Graphics, Textiles, Tutoring, Veterinary Medicine, Weaving, and Zoology. The program was covered by local news media several times during the school year and the rewarding effects to the students can be attested to by the following comments from students involved in the program.

> I feel like I'm learning a lot more than I could in school; at school you just get the theory, but when you get out into the field working, it makes school much more interesting.
>
> The people are great and I'm learning a lot about getting along with people--I realize how protected I am in a high school situation.
>
> Being responsible for what you're doing is really important. It's a chance to do things not offered at school and to investigate things.
>
> WHY is broadening in a lot of ways. Students don't know people other than teachers can teach them--it's an opportunity to use professional people to learn. It makes it much better when you go back to regular classes.

A meeting was held in the spring of 1975 for parents of WHY students and school personnel. At this time a survey was conducted of the parents relative to their feeling about the WHY program and their child's participation in it. The results of the survey indicated that the parents felt:

1. Students had a more positive attitude toward school
2. Students did not suffer academically
3. Parents would permit child to repeat the experience

Additional activities proposed and in process include:

1. Responsibilities of counselors are being revised to include working with students in the areas of self awareness and career awareness and developing student profiles so their educational experiences will be related to their interests and abilities, and relating the student profile material to the exploration of specific career interests. Supplementary educational materials have been examined and several units have been purchased to start working with small student discussion groups. The school psychologist will serve as a resource person and cooperating group discussion leader.

2. Department chairmen are making plans for rewriting curriculum which is more meaningful and life related. Consideration is being given to block time observation and exploration of careers.

3. Plans are being made to update the listing of community resource persons who have indicated a willingness to share their time and talents with the schools.

4. Materials have been collected, catalogued, and made available to students.

5. Career Days are being planned for high school students. A Career Day was held for juniors and seniors in the spring of 1975 which covered some 40 career areas and was very successful.

Evaluation has been an ongoing process involving students, teachers, the coordinator, administrators, the project director, consultants, parents, and a university professor.

In order to provide for continuity of the educational program, the students "checked in" daily with the coordinator and plans were developed or revised. The students met weekly with the coordinator and/or parents, school personnel, and resource persons.

In an attempt to provide more effective techniques in the teaching/learning process, the students were given much responsibility for selecting resource persons, determining related activities and reporting the activities, and evaluating what was done and relating it to in-school activities and curriculum, and planning future activities. Evening meetings were held weekly for students and the coordinator and served as both planning and evaluation sessions. Additional attendees at the meetings were parents, consultants, administrators, and the program director.

Intensive exploration of numbers of careers with active participation by the students under the supervision and direction of resource persons was reflected in verbal and written testimonials by the students.

The program director had several conferences with a university professor who is very knowledgeable about career education and an expert in curriculum development and incorporated his suggestions into the program development.

There is no question as to the success of the WHY program for a student who wishes to have a less structured program and who is capable of assuming a good deal of responsibility for planning his program. There are numbers of suburban communities similar to Wyoming who would profit from materials and experiences that could be developed through the kind of activity and educational refocus which this kind of individualization offers.

The opportunity afforded through the implementation of the experimental WHY program and the opportunity to coordinate some thinking and plans across the system made a significant contribution to the program at Wyoming High

School, not only in the positive evaluations made by students, parents, staff, and administration. but the success is also attested to by the doubling of the number of applicants for the program for 1975-76.

It is only realistic to point out at this stage in the operation of the program that an individualized program to be successful as an ongoing available program requires provision for personnel to coordinate the activities and programs of the students, to research materials, to write curriculum, to make recommendations to keep materials up-to-date as far as selection and development is concerned, and to work with consultants and community resources.

ACCESSION NUMBER: VT102512

PUBLICATION DATE: JUN75

TITLE: AGRI-BUSINESS LEARNING ACTIVITY AUDIO-VISUAL DEVELOPMENT. FINAL REPORT.

PERSONAL AUTHOR: LARSHUS, LEONARD

DESCRIPTOR: *AGRIBUSINESS; LEARNING ACTIVITIES; *AUDIOVISUAL AIDS; *POST SECONDARY EDUCATION; SLIDES; ADULT STUDENTS; *AGRICULTURAL SKILLS; SECONDARY EDUCATION; SECONDARY SCHOOL STUDENTS

IDENTIFIER: NORTH DAKOTA

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 45P.

ABSTRACT: THIS DOCUMENT REPORTS THE PREPARATION OF SLIDES TO DEMONSTRATE THE STEPS IN PERFORMING SELECTED AGRICULTURAL SKILLS. THE SLIDES WERE ASSEMBLED IN SETS WITH A SCRIPT RECORDED ON A CASSETTE TAPE. EIGHT SETS, COMPOSED OF 16 AND 28 SLIDES EACH, WERE COMPLETED ON THE FOLLOWING TOPICS: (1) TAKING A SOIL SAMPLE, (2) DOCKING AND CASTRATING LAMBS, (3) CASTRATING PIGS, (4) HOW TO PLANT A TREE, (5) THE USE OF SYRINGE FOR INTRAMUSCULAR INJECTION, (6) DEHORNING CALVES, (7) CASTRATING CALVES, AND (8) SOW AND SMALL PIG CARE. THE SETS ARE SUITABLE FOR INDIVIDUAL OR CLASSROOM USE. THEY WERE DEVELOPED FOR USE WITH POSTSECONDARY STUDENTS, BUT MAY BE USED FOR TEACHING SECONDARY OR ADULT STUDENTS. APPENDED ARE DESCRIPTIONS OF AND THE NARRATIVE FOR THE SLIDES. (LJ)

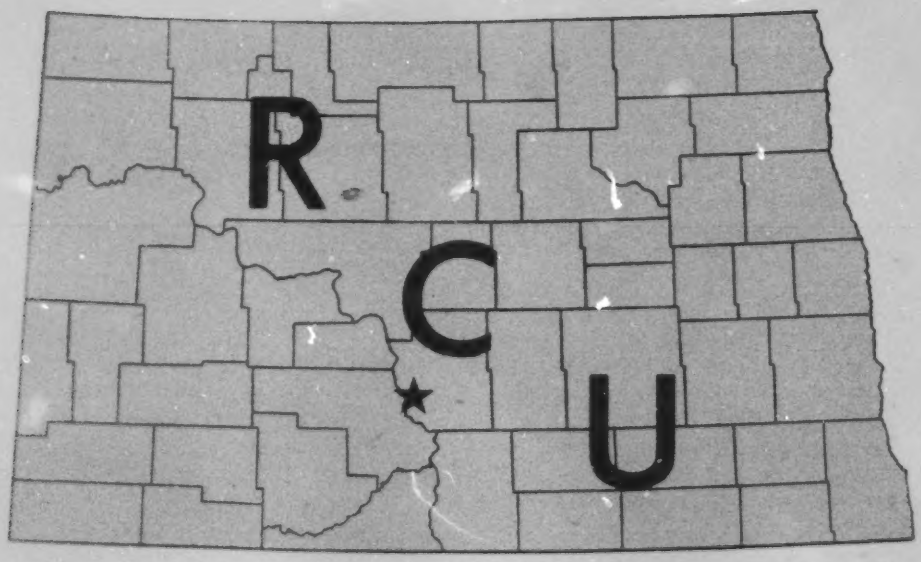
INSTITUTION NAME: BISMARCK JUNIOR COLLEGE, N. DAK.: NORTH DAKOTA STATE BOARD FOR VOCATIONAL EDUCATION, BISMARCK, RESEARCH COORDINATING UNIT.

SPONSORING AGENCY NAME: OFFICE OF EDUCATION (DHEW), WASHINGTON, D.C.

102 512

RESEARCH SERIES NO. 17

AGRI-BUSINESS LEARNING ACTIVITY
AUDIO-VISUAL DEVELOPMENT



NORTH DAKOTA
RESEARCH COORDINATING UNIT

STATE BOARD FOR VOCATIONAL EDUCATION
STATE OFFICE BUILDING
BISMARCK, NORTH DAKOTA 58501

VT 102512

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DON ESHELBY, Director

1972

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FINAL REPORT

Agri-Business Learning Activity
Audio-Visual Development
Project Number 17

SUBMITTED BY

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in cooperation with

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Abstract

This project involved the taking of slides showing the steps in performing selected agricultural skills. The slides were assembled in sets with a script recorded on a cassette tape. Eight slide sets were completed. These included the following, with the number of slides in each set indicated:

Taking A Soil Sample	16
Docking and Castrating Lambs	20
Castrating Pigs	16
How To Plant A Tree	28
The Use of Syringe For Intramuscular Injection	18
Dehorning Calves	16
Castrating Calves	20
Sow and Small Pig Care	27

The audio-visual teaching aids were developed to be used with individual learning packets which had previously been developed by the North Dakota Post Secondary Agri-Business instructors. In addition to being useful for the student to use for individual study, the teaching aids are also suitable for class room use. While they were developed for the use with post secondary students, it appears that they are equally useable for teaching secondary and adult students.

Acknowledgements

The development of the Agri-Business Learning Activity Audio-Visual Aids was due to the combined efforts of a number of people. Each of the eight slide sets and cassette tapes were developed by North Dakota Post Secondary and Adult Agri-Business instructors.

A special appreciation is expressed to the administration of each of the four Junior Colleges for their cooperation and consideration during the time these audio-visual aids were being developed. Thanks is also expressed to Norbert Mayer, Assistant State Supervisor of Agricultural Education, for their assistance and advice during the completion of this project. Thanks to a number of North Dakota Vocational Agriculture instructors for assistance in viewing and editing the teaching aids.

The following instructors are credited with aiding in the development of the teaching aids:

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Introduction

During the 1973-74 school year North Dakota Post Secondary Agri-Business instructors developed twenty-one learning activity packages for Agri-Business. This was completed under research project number 12. The individual learning packets were developed to meet a need of students and assist in the teaching of skills required in many of the agricultural occupations. During the writing and field testing of the individual job packets it became apparent that there was a need for audio-visual teaching aids to be used to supplement the individual job sheets.

In an effort to partially meet this need Bismarck Junior College submitted a proposal for a Research Mini Grant from the North Dakota State Board for Vocational Education.

Methods

Following the approval of the application for a Mini Grant to finance the development of the audio-visual aids, a meeting of the Agri-Business instructors from the participating schools was held. During this meeting ten of the twenty-one individual job skills were selected for the developing of teaching aids. At this same meeting instructors were assigned the job skills for which they were to develop the audio-visual aids. Individual instructors took the responsibility of taking the needed slides, organizing them into a series and writing the script to be recorded on a cassette tape. After the slide sets were tentatively selected and the script written, they were viewed and edited by Agricultural Educators. Changes were made wherever the need for improvement was seen. Following evaluation and editing the scripts were recorded by Mr. Al Gustin, radio and TV announcer. Of the ten skills tentatively selected for developing of teaching aids, eight sets were completed.

Results and Findings

The following is a list of the slide sets and the number of slides in each set. In addition to the slides a printed and cassette tape recorded script has been developed for each set.

Taking A Soil Sample	16
Docking and Castrating Lambs	20
Castrating Pigs	16
How To Plant A Tree	28
The Use Of Syringe For Intra-muscular Injection	18
Dehorning Calves	16
Castrating Calves	20
Sow and Small Pig Care	27

The complete printed scripts are contained in appendix A.

Conclusions and Recommendations

The original intent for the use of the slide series and recorded scripts was to supplement the use of the individual learning activity packages previously developed by the North Dakota Post Secondary Agri-Business instructors. During the period of development it became increasingly apparent that they would also be suitable for classroom use. While the teaching aids were developed primarily for use in teaching post secondary Agri-Business students it appears that they would be equally effective for teaching secondary and adult students.

Since the slides and recorded script give step by step procedures for performing an operation, students having no previous knowledge of the skill can learn the basic steps from the teaching aids. In many cases he should be able to go on the job and perform the skill without any further instruction or demonstration. The student, who has had some experience performing the skills, can also improve his technique and knowledge from the viewing of the slides and listening to the tapes.

The slide sets, printed scripts, and cassette tape recorded scripts are available from the Agri-Business Department, Bismarck Junior College, Bismarck, North Dakota 58501. The following is the 1975 price list:

Taking Soil Sample	$14.00
Docking and Castrating Lambs	16.00
Castrating Pigs	14.00
Castrating Calves	16.00
Dehorning Calves	14.00
How To Plant A Tree	21.00
The Use of Syringe For Intra-muscular Injections	15.00
Sow and Small Pig Care	20.00

If all eight sets of slides, printed scripts and tapes are ordered in one order, the price is $115 for all sets.

APPENDIX A

Description and Narration of Slides

Taking A Soil Sample
Script for Slide Series

1. TITLE SLIDE -

2. SOIL TESTING CIRCULAR - Soil testing circulars are available at most county extention offices or fertilizer dealers. The circular explains sampling procedures for the various tests offered by the soil testing laboratory as well as cost for each test performed. Use this cirular as a guide for determining when, where, and how soil testing should be done.

3. SAMPLING INFORMATION SHEET - This soil sample information sheet becomes a part of each sample taken. All the records required for meaningful analysis are recorded on this sheet. Information on this sheet should include land discription, cropping history, yield goal, and the test to be performed by the soils laboratory.

4. EQUIPMENT - Selection of the proper tools may make soil sampling much easier. From left to right; the short probe, the regular probe, sampling pails, soil auger, auger sampling device, (collects soil as the auger is pulled from the soil) and the spade.

5. FIELD TO BE SAMPLED - Size up your field very carefully so that your soil analysis becomes meaningful. Don't sample areas which are distinctly different than the major part of the field. Remember that soil type, problem areas, and past management are factors which should be considered prior to sampling. This field appears to be relatively free of problem areas, although a saline problem does exist on the far end and will not be sampled.

6. SOIL PROBE IN USE - The soil probe is one of the fastest tools available for soil sampling. Shown here the 0-6 inch depth is being sampled. Normally it is very difficult to probe 24 inches with this hand probe. Mechanical probes are available for faster sampling, either on a purchase or rental basis.

7. SAMPLE CORE - This soil core is collected in the sampling pail, each sample becomes a part of the total field sample.

8. USE OF SPADE IN SAMPLING - The spade is also used mainly for the 0 to 6 inch sampling depth. A hole is dug and then a thin slice is taken to make a sub-sample.

9. CORING THE SPADE SAMPLE - The thin slice is then prepared using a putty knife to obtain a uniform sub-sample similar to that of the soil probe. This also reduces the size of the total sample.

10. COMPLETED SPADE CORE - The sub-sample is shown here as it becomes a part of the total field sample. Normally 20 sub-samples are collected from each field to make a sample for analysis. This method increases the accuracy of the test analysis.

11. SAMPLING WITH THE SOIL AUGER - The soil auger and collecting device is used when sampling to the 24 inch depth or if the soil is very hard and dry. Note the collection of the sample in the sampling device as the auger is withdrawn from the hole.

12. SAMPLE COLLECTION - From each location a 0 to 6 inch sub-sample and a 6 to 24 inch sub-sample is collected. Only a portion of the 6 to 24 inch sub-sample is saved from each location on the field. It would be impossible to collect all of the soil from 20 locations in one pail.

13. SAMPLE MIXING - Once the total field has been sampled each container is mixed thoroughly to create a uniform sample.

14. SAMPLE DRYING - Enough of the sample to fill the sample bag is now placed out to dry. Drying should be done at roon temperature. Do not oven dry. Be careful not to contaminate the sample with fertilizer, bird droppings, or other foreign material. Drying normally takes about 24 hours.

15. PREPARATION FOR MAILING - Sample bags are filled and labeled. Make sure the identification number and sampling depth are printed on the sampling bag. Phosphorus and potassium tests are done on the 0 to 6 inch depth and nitrogen tests are completed on the 0 to 24 inch depth. With the information sheet completed your samples are ready for mailing.

The analysis which is returned to you with the recommendations for fertilization is only as good as the collection and preparation of your soil sample.

Docking and Castrating Lambs
Script for Slide Series

1. TITLE SLIDE - This series of slides will demonstrate the common methods of castrating and docking lambs. All male lambs not to be left as rams should be castrated when they are 7 to 14 days of age. Strong lambs may be castrated and docked at the same time, with castrating being done first. All lambs reqardless of sex should be docked. Docking is a recommended practice in sheep management for two primary purposes; Sanitation and permits breeding of ewes more readily.

2. INSTRUMENTS - The instruments used most commonly for castrating and docking lambs are as follows: the knife which is located at the top of the slide; the all-in-one instrument, lower left; emasculator, in the middle; and the elastrator on the lower right.

3. METHOD OF RESTRAINING - The most common method of restraining lambs is to clasp both fore and hind legs of the left side with your left hand and the right fore and hind legs with your right hand. The position of the lamb while being restrained will depend upon the person doing the castrating and docking.

4. DISINFECTING - Properly disinfecting the scrotum is the first step in castrating lambs. An approved disinfectant by your local veterinarian or farm supply store should be used. Sheepmen and veterinarians are noticing little difference in disinfecting and not disinfecting, only if equipment you are using is properly disinfected.

5. CUTTING SCROTUM - After disinfecting the scrotum, the lower 1/3 of the scrotum should be cut off with either an all-in-one instrument as shown here or ---

6. CUTTING SCROTUM - A knife. It is recommended that either instrument used should be put in a disinfectant solution after each lamb.

7. EXPOSING TESTICLES - When the lower 1/3 of the scrotum has been cut off, you use your index finger and thumb to force the testicles out. If not enough of the scrotum is removed, difficulty will be encountered in forcing out the testicles.

8. REMOVING TESTICLES WITH TEETH - The operator will then bite firmly in the middle of the testicles making sure a firm hold is kept on the cord.

9. REMOVING TESTICLES WITH TEETH - Here the testicle and cord are being removed with index finger and thumb still in firm contact with the lamb. Using your teeth to remove the testicles is one of the oldest and cleanest methods used and still is recommended today.

10. REMOVING TESTICLES WITH THE ALL-IN-ONE INSTRUMENT - Another method recommended for removing the testicles is the all-in-one instrument which has jaws at the end. The jaws are clamped over the testicle with one hand while the other hand is used to force the testicle out and counteract the force of pulling the testicle out.

11. REMOVING TESTICLES WITH THE ALL-IN-ONE INSTRUMENT - Here we see the testicle and cord as it is being removed.

12. CASTRATING WITH THE ELASTRATOR - Another method of castrating lambs is with an elastrator. This is a bloodless method of castration. This slide shows the operator forcing the testicle to the lower end of the scrotum.

13. CASTRATING WITH THE ELASTRATOR - The elastrator is an instrument for use in stretching a specially made rubber ring, which may be placed around the scrotum to castrate young lambs. Press both testicles through the ring and to the lower end of the scrotum and then release the rubber ring.

14. RUBBER RING PLACEMENT - Note the placement of the rubber ring after the elastrator had been removed. Make sure to check if both testicles are in the scrotum. The rubber ring will cut off the blood supply and the scrotum and testicles will deteriorate and fall off in time. This method of castration is not recommended because there appears to be more pain to the lamb and greater frequency of infection.

15. DOCKING WITH AN ELASTRATOR - Docking lambs with an elastrator is used by some sheepmen. Again this practice is not recommended for the same reasons as in castration. If this method is used, the rubber ring is stretched with the elastrator over the tail and placed approximately one inch from the body.

16. RUBBER RING PLACEMENT ON TAIL - Notice the rubber band after removal of the elastrator. The rubber band cuts off the blood supply and loss of tail will occure in time.

17. DOCKING WITH THE EMASCULTOR - Another method more commonly used is the emasculator. The emasculator is placed approximately 1 inch from the body.

18. DOCKING WITH EMASCULATOR - After the tail is severed, the emasculator is held in place for a few seconds. This aids in preventing excessive bleeding.

19. USING STOP BLEED POWDER - Apply a small amount of stop bleed powder recommended by a local veterinarian or farm supply store. In conclusion, remember, castrating and docking should be done when lambs are 7 to 14 days of age. Castrating lambs should be done first, followed by docking the lamb.

CASTRATING PIGS
Script for Slide Series

1. TITLE SLIDE-This slide series will demonstrate some of the commonly used methods of castrating pigs. Male pigs which are not to be kept for boars should be castrated at the age of one to four weeks or earlier. When castration is done at an early age they will recover more rapidly and are easier to handle than if castrated later.

2. MIXING DISINFECTANT - One of the requirements for castration is a suitable disinfectant which is available at any veterinary supply store. The disinfectant should be measured out and mixed with water as recommended. A shallow pan type container is easy to work with and is recommended over a deeper pail.

3. CASTRATING EQUIPMENT- The equipment needed for castrating pigs is very simple. In addition to the disinfecting solution a sharp tool for making the incision is all that is usually needed. A sharp castrating knife, a single edged razor blade or a scalpel, as shown here, can be used.

4. RESTRAINING SMALL PIG IN TROUGH-There are several different methods of restraining pigs for castration. The method selected may depend on the size of the pigs being castrated and the method the individual may prefer. The use of a trough or crate aids the holder in keeping the animal from moving around. The holder grasps the hind legs firmly, holding them against the body tightly so the animal can not kick or move around.

5. RESTRAINING PIG VERTICAL BY HIND LEGS-Some hogs men prefer to suspend the pig by his hind legs with his back toward the holder. The holder can also clamp his knees against the pigs ribs near the shoulder.

6. COMMERICAL PIG HOLDER-A commerically made pig holder will hold a pig restrained, making it possible for one man to do the job of castrating. It is adjustable to accommodate pigs of different sizes, however, some pigs may be too small or too large for the holder.

7. ONE MAN RESTRAINING AND CASTRATING-Another one man operation. The operator is holding a very small pig on a bench. While this method works well on small pigs the person castrating pigs for the first time may prefer to use a holder. The pig being castrated here is three days old.

8. DISINFECTING SCROTUM-Holding the pig with its back on a bench is a commonly used method. The holder should grasp the hind legs firmly and hold them down against the body of the pig, no special equipment is needed for this method of restraining.
The scrotum is being washed liberally with the disinfectant. Prior to this the operator should wash his hands with soap and water. His hands and knife or scalpel are rinsed with the disinfectant.

9. TESTICLE BEING EXTENTED-After properly cleaning and disinfecting the scrotum and surrounding area, pressing down on the scrotum on each side of the testicles with your fingers will extend the testicle making it easier to properly locate the incision site.

10. MAKING INCISION-With a sharp knife or scalpel, slit the scrotum as the testicle is pressed outward. Extend the cut well down to allow for proper drainage and cut deep enough to extend through the scrotum and the membrane. If the incision is too small, it will heal on the outside before the inside of the wound has healed, this can result in infection.

11. INCISION THROUGH MEMBRANE-After the slit has been made on the scrotum, it may be necessary to make a second slit across the testicle to cut the membrane. This slit should be made the full lenght of the testicle, pressure with the fingers on the back side of the testicle will cause the testicle to pop out.

12. PULLING TESTICLE-As the testicle is grasped between the fingers and pulled outward, the attached membrane will come out also.

13. CUTTING MEMBRANE-Using the knife or scalpel the membranes are cut away from the testicle as it is being pulled outward.

14. PULLING TESTICLE-On small pigs the testicle and cord can be pulled, while on older hogs it may be necessary to scrape the cord with the scalpel near the body of the animal. After removing the testicles from one side the same steps are followed to remove the testicle from the other side.

15. CASTRATED PIG REAR VIEW-The completed job should show two even cuts. When the operation is completed the animal is turned into a clean stall. Do not permit animals recently operated on to go into mud wallows or dusty dirty quarters.
While it is generally recommended to castrate pigs at an earlier age than the one shown here, a larger pig was used to make the operation more visable to the viewer.

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Castrating pigs is a simple operation that can easily be completed by any beginning hog raiser. If the simple steps that have been outlined are followed no problems should be expected. Pigs should not be castrated, wormed, vaccinated, or weaned at the same time. These operations should be spaced at two-week intervals to limit the amount of stress on the pigs at any one time.

16. CREDIT SLIDE

How To Plant A Tree
Script for Slide Series

1. TITLE SLIDE - Trees and shrubs are usually available in four different forms for planting. These are (a) Bare-root (b) Potted (c) Container grown, and (d) Balled and Burlapped.

2. EQUIPMENT - The tools needed for planting trees and shrubs include pruning shears, pocket knife, tin snipes, shovel and a stick for tamping the soil firmly around the roots.

3. SOAKING IN WATER - Bare-root plants are the most economical to buy but the most difficult to store and establish. They have no soil around their roots, therefore care must be taken to insure that the roots do not dry out before they are planted. Bare-root plants should be kept in a moisture retaining media until the time they are to be planted. Immediately prior to planting they should be soaked in water over night. This will insure that the plant takes up as much water as possible prior to planting. Do not soak the root system in water for longer than 24 hours.

4. HOLE DUG - Dig a generous sized hole wider and six inches deeper than the root spread. Separate the black top soil from the clay sub soil. Replace clay with good top soil when refilling the hole.

5. BARE-ROOT TREE IN HOLE - Prune out damaged or weak roots. Set the plant on a firm mound of good topsoil. Spread out the roots as you fill in the hole with good topsoil.

6. FILLING HOLE - Fill in the hole with topsoil. The plant should be planted slightly deeper than it was in the nursery.

7. TAMPING SOIL - Tamp soil firmly around the plant using your tamping stick or your foot.

8. PRUNING TREE - The roots will have lost most of its root hairs in the process of digging and transplanting, therefore the plant will be hindered in taking up water. Prune back the shoot to compensate for the loss of root system. The shoot may be pruned back as much as 1/3 of its whole length.

9. WATER BASIN - Build a basin around the base of the tree to hold water. The basin will enable the water to soak into the root system before it can run away.

10. WATERING - Immediately after planting fill basin with water. Allow water and soil to settle. Add more soil and reshape basin after settling.

11. POTTED TREE AND HOLE - Potted stock is that which was planted in pots this spring. Dig a generous size hole to allow for root expansion. Keep the topsoil, but discard clay sub soil and replace with good quality topsoil.

12. CHECKING SIZE OF HOLE - Determine proper hole size before removing plants from pot. Plant slightly deeper than it was in the pot. Put a mound of good topsoil in the bottom of the hole for roots to grow into.

13. REMOVING CONTAINER - Always remove pots at planting time regardless of pot material. Use knife or tin snips to cut pot open.

14. REMOVING CONTAINER - If the container is of plastic cut both sides, bend out and remove the plant. Handle plant and ball very carefully because the root system still isn't big enough to hold the soil around it. If the container is made of fiberous material slit one side and cut out the bottom. Do not remove the container until the plant has been set in the hole.

15. TREE PLACED IN HOLE - Place plant in hole deep enough so that it is slightly deeper than it was in the pot.

16. TAMPING SOIL - Fill in hole with good quality topsoil. Tamp firmly but not hard.

17. PRUNING - Prune off dead or injured branches.

18. WATER BASIN AND WATERING - Construct basin around base of plant. Fill with water and allow to settle. Add more soil after settling and reshape the basin.

19. CONTAINER GROWN TREE AND HOLE - Container grown plants will have benn grown in the container at least one year. The root system will have developed enough so that it will be able to retain the ball of soil around it when the container is removed. Dig an ample size hole to allow for future root growth. Seperate the black top soil from the clay sub soil. When refilling the hole replace the clay sub soil with good top soil.

20. CHECKING SIZE OF HOLE - Plant the plant slightly deeper than it was grown in the container. Dig the hole deep enough so that a firm mound of rich top soil can be placed under the plant.

21. CUTTING SIDE OF CONTAINER - Plants grown in tappered containers can be removed by turning upside down and tapping the edge of can against solid object. The plant and root ball will drip out in tack. If the plant is grown in a straight sided can you will have to cut the can to remove the plant. Cut down the full length of both sides of the can.

22. REMOVING CONTAINER - After the sides of can are cut bend the sides out and remove plant and soil ball.

23. TAMPING SOIL - Lower the plant into the hole gently to prevent the soil ball from crumbling. Fill in the space around the soil ball with good topsoil. Tamp soil firmly but not hard.

24. PRUNING - Construct a soil basin around base of plant to hold water. Water thoroughly to insure that the root system is completely soaked. Add more soil and reconstruct basin after settling. Remove dead or injured branches with your pruning shears.

25. BALLED AND BURLAPPED TREE AND HOLE - Balled and burlapped plants consist of plants that have been dug out of the soil with a ball of soil around the roots. The ball of soil is wrapped with burlap to insure that it does not fall apart. Always handle a balled plant by the ball and not by the plant stem. Dig the hole deep enough and wide enough to allow for future root growth. Dig the hole deep enough so that with a mound of good topsoil in the bottom of the hole the plant will sit 2-3" deeper than it was in the nursery.

26. TREE PLACED IN HOLE - When the hole is of proper depth lower the balled plant into the hole.

Cut the twine securing the burlap after it has been placed in the hole. Fold down the upper portion of burlap, but do not remove burlap from ball. Fill hole with good quality topsoil. Tamp thoroughly with your tamping stick or your foot.

27. WATERING TREE - Build a basin of soil around base of plant. Fill basin with water and allow it to settle. Add more soil and reshape basin after settling. Larger balled and burlapped plants will have to be staked to insure that they remain straight.

28. CREDIT SLIDE -

The Use of Syringe for Intramuscular Injection
Script for Slide Series

1. TITLE SLIDE - Various types of injections are used for prevention and treatment of diseases. An intramuscular injection is a route of medication where the fluid medication is deposited directly into the larger muscle tissue or meat. This type of injection is used for various types of medication, especially certain antibiotics. The medication is then absorbed from the muscle tissue into the blood stream of the animal. This medication will start entering the animals system almost immediately. Not more than 25 cc's should be injected in any one spot in large animals such as cattle, horses and heavy hogs. Where the dosage to be given is large, as much as 500 cc's can be injected into cattle by distributing the dosage in 25 cc amounts into the heavy muscles of the neck, shoulder and hind quarter on both sides. In small animals such as sheep, pigs and dogs not more than 10-15 cc's should be injected in one spot.

2. EQUIPMENT - The equipment needed to give an intramuscular injection can include various sizes of disposable syringes which are intended to be used once and discarded, various sizes of standard veterinary syringes which can be reused after cleaning and boiling and the cartridge type gun or auto-syringe which can be used when there are a large number of animals which are receiving the same medication.

3. DISASSEMBLED SYRINGE BOILING IN WATER - The veterinary syringe should be clean before giving the injection. In most cases a thorough rinsing with clean water without disassembling is all that is necessary. Occassionally it will be necessary to thoroughly clean and disinfect the syringe and needles by

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first disassembling and washing with soap and water, rinsing and then boiling in water for ten to twenty minutes. The syringe can also be disinfected by the use of chemicals but since some chemicals can destroy certain live vaccines it is best to always rinse with water after chemical disinfection. Boiling is the recommended way of sterilization.

4. DISASSEMBLED SYRINGE SHOWING ALL PARTS - This is a 40 cc veterinary syringe completely disassembled. When assembling remember that the fiber seal or gasket goes on top of the glass cylinder and the rubber seal or gasket goes on the bottom of the galss cylinder. Careful observation during the disassembly will help to insure correct assembly.

5. SYRINGE BEING ASSEMBLED - SHOWING THE GLASS CYLINDER - To avoid contamination the inside of this glass cylinder should not be touched during assembly as it will be in contact with the medication or vaccine. This glass cylinder can be broken if the syringe is not disassembled for boiling.

6. SYRINGE BEING ASSEMBLED - SHOWING THE PLUNGER - The end of the plunger shown here is another internal part that comes in contact with the material and should not be touched. A lubricant such as vaseline or glycerine can be used on the sides of this plunger to make it easier to move and still insure a tight seal.

7. SYRINGE BEING FILLED WITH MEDICATION - After reassembly the syringe is then ready to be filled. Before inserting the needle shake up the bottle. Then the needle is forced into the rubber stopper and the plunger is slowly withdrawn to fill to the desired level. This creates vacuum in the bottle and can result in slow filling especially where large amounts of material are

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withdrawn from the bottle. To overcome this withdraw the plunger to fill the syringe with air before forcing the needle into the rubber stopper. Then inject some or all of the air into the bottle and suck some or all of the material needed into the syringe. When the material goes to the top of the syringe, holding it upside down as shown here, inject more air into the bottle and suck more material into the syringe. Keep this process up until the syringe is as full as desired. When more than one injection is to be given with the material from the same bottle it may be desirable to use a poor needle to fill the syringe and leave this needle in the bottle and use a newer and sharper needle or needles to give the shots. This will prevent contamination of bottle contents from the needle used to give the injection.

8. PIGS CROWDED IN CORNER RECIEVING SHOTS - The animal should be restrained by the best means available. A stanchion or chute can be used for large animals. When a group of animals are to be injected they can be crowded into an alley or a gate can be utilized to crowd the animals thus restraining them and the injection given. The pigs shown here can be crowded into a pen corner where the injections are given. After the injection they should be marked so they do not get injected more than once.

9. PIG BEING HELD SHOWING INJECTION SITE - A smaller animal such as the pig shown here may be restrained by an assistant. An intramusclar shot for pigs is usually given in the ham.

10. INJECTION SITES ON LAMB - The preferred intramuscular injection sites on a sheep is the thigh. It is sometimes recommended that the injection site for all animals be cleaned with an antiseptic solution such as a 70% alcohol solution. However many stockmen and veterinarians have not experienced any adverse effects by not using antiseptic solution at the injection site. In

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cases where the injection site is extremely dirty it may be necessary to clip the hair or wool and wash the area to prevent infection.

11. INJECTION SITES ON CATTLE - The preferred intramuscular injection sites on cattle are the neck and two places on the hind quarter or thigh. Before making an injection read the bottle label and direction sheet carefully or contact your local veterinarian to determine cautions, proper dosage, frequency of administration and the recommended method of administration. Be sure you are using the proper medication as recommended by your veterinarian It is also important that the medication be stored properly.

12. SYRINGE READY TO BE THRUST INTO MUSCLE - The needle should then be inserted deep into the muscle tissue at right angles to the skin with one quick thrust. Some prefer to insert the needle alone and then attach the syringe while others prefer to insert the needle while attached to the syringe as shown here. After the needle is inserted some prefer to observe the hub of the needle or withdraw the plunger slightly to see if there is any blood. If blood is observed they will then withdraw and reinsert the needle at a different site to avoid injecting the medication in a blood vessel. Some products could cause a problem if put into a vessel but reports of this are rare. Some people prefer to tap the injection site with their hands or fingers a few times to prepare the animal for the shot so it does not jump when the needle is inserted.

13. SYRINGE WITH NEEDLE IN CALF AND THE MATERIAL BEING INJECTED - The material should then be slowly injected into the animal. After the medication has been injected pull the needle straight out. After the needle is withdrawn

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the injection site is often rubbed or messaged to spread the medication and to help close up the hole that the needle made. In very rare cases after the injection the animal will have violent reaction which will usually end in death. This is known as anaphylatic shock, alergic or post injection reaction. Many deaths blamed on this are actually caused by rough handling or wrong methods of restraint.

14. SUBCUTANEOUS INJECTION SITES ON CATTLE - Another type of injection is the subcutaneous injection. The equipment needed and preparation of the animal are the same as for intramuscular injection. In this type of injection the medication is put directly under the layers of skin. It is usually given in places where the skin lies loose in folds. In cattle this injection is often done in the neck but can also be accomplished by using a 1/4 inch needle and going directly into the skin at any site.

15. SUBCUTANEOUS INJECTION SITES ON SHEEP - In sheep the subcutaneous injection is often made in the axillary space or the arm pit. Another site for this shot is the neck of sheep. Where many sheep need the same product they are usually crowded into a pen or alley where the person giving the injection parts the wool on the neck and gives the shot.

16. SUBCUTANEOUS INJECTION SITES ON A LARGE HOG - On large hogs most subcutaneous injections are given with a shorter needle just behind the ear. This site is sometimes used to give intramuscular injections, especially for baby pigs. When giving baby pigs injections behind the ear care should be taken not to use too long a needle that might result in injury to the spinal column.

17. SUBCUTANEOUS INJECTION SITES ON A SMALL PIG - The subcutaneous shot on baby pigs can be given in the axillary space as shown here. If the pig is held by the front legs this shot can also be given in the axillary space of the front legs. Injections are made for prevention or treatment of a disease. There are many other types of injections besides the intramuscular and subcutaneous that are given to animals. These should be given by or under the supervision of the veterinarian. Regardless of the type of injection the medication will start entering the animals system immediately.

Dehorning Calves
Script for Slide Series

1. TITLE SLIDE - One job stockmen are faced with is dehorning cattle. The slide series shows some of the equipment and methods that can be used in the dehorming process. Horned cattle use more trough space in the feed lot, prevent other cattle from feeding properly and may cause bruises that lower carcass values. Dehorned cattle look more uniform, feed better, and bring a higher market price.

2. EQUIPMENT - A good job of dehorning requires proper equipment and proper preparation. Instruments used must be cleaned and disinfected, before and after each operation to prevent the introduction and spread of disease.

   Age is an important factor in dehorning and often determines the method to be used. The type of instrument best suited to a particular operation depends largely on the horn size. Do the dehorning as soon as you can. The younger the animal the easier it is to handle. The after effects young animals suffer are usually slight and if done properly the first time, their dehorning need never be repeated.

   There are several ways to dehorn and also several instruments to use. These instruments from left to right in the back row are: Leavitt clippers, large Barnes dehorner, tube dehorner, dehorning paste.

   In front is the disinfecting solution, dehorning paste (in jar) and the tube dehorner.

3. HORN BUTTON ON SMALL CALF - At a very early age the horn will appear as a small button or knob.

4. HORN BUTTON BEING CUT OFF - In preparation for applying a chemical dehorning paste, the surfaces of the horn button is cut off, scraped or filed depending on the manufactures recommendations.

5. APPLYING PASTE TO HORN BUTTON - Dehorning paste can be purchased in various forms including the stick, paste in a jar, and paste in a tube as being shown spplied here. When using dehorning paste, just cover the button with a dime thickness of paste, or about 1/16 of an inch of paste. Prevent the paste from contacting the skin of either calf or yourself. Paste applied directly to unprotective skin burns it severely.

6. HORN BUTTON AFTER PASTE HAS BEEN APPLIED - The finished job has a thin film of paste covering the horn button. Care should be taken to avoid too much paste which can result in the paste washing down over the face of the animal.

7. HORN AN OLDER CALF - As the calf gets older the horn button grows and developes as a small horn. Horns of this size are too large to be removed with chemical dehorning paste.

   Horns of this size can be removed with a tube dehorner or a spoon dehorner which is often called the gouge.

8. THE USE OF THE TUBE TO DEHORN - The cutting edge of the tube is placed straight down over the base of the horn. The tube should be large enough so that about 1/4 of the skin is cut all around the base of the horn. The gouge is pushed and twisted until the skin has been cut through, making a cut 1/8 to 3/8 inch deep. The tube is then turned to about a 45^0 angle and shoved until the button comes off.

9. APPLYING BLOOD STOP - There will be a small amount of bleeding with the use of the tube or gouge. The use of a commercial product for stopping the bleeding is sometimes used.

10. RESTRAINING AN OLDER CALF FOR DEHORNING - When older animals are being dehorned it is important to use effective and humane methods of restraining animals. Adequate restraining equipment is needed. Young calves can be thrown on the ground or snubbed to a post. Older cattle must be held in a squeeze chute or head gate.

11. DEHORNING WITH WIRE - There are several methods of cutting off the horns of older animals. The wire is one effective method. The wire is placed around the base of the horn. The cutting action is gotten by pulling back and forth with alternate hands. Handles are available for the wire, which makes it easier to use. Care must be taken to avoid getting the hands cut.

12. DEHORNING WITH BARNES DEHORNER - The Barnes dehorner will remove horns on calves from two to ten months of age. The dehorner is places well over the horn with the handles closed together. Quickly and carefully spread the handles apart to close the blades and remove the horn.

To assure a good job, place the dehorner down over the horn far enough so that one-quarter inch ring of skin is removed with the horn. This will allow new skin to grow over the horn base and also prevents further horn regrowth.

13. DEHORNING WITH MECHANICAL CLIPPERS - For more mature animals the mechanical clippers can be used. Make the cut about one-quarter to one-half inch below the junction of the horn with the skin. Removing a ring of skin will prevent further horn growth. When larger animals are dehorned bleeding can be minimized by using a forceps or tweezers. Pull and twist the bleeding arteries until the break off. The break will occur deep within the head where clotting will occur more easily.

14. APPLYING BLOOD STOP TO THE DEHORNING SITE - Flour or a commercial coagulant will help to control bleeding. A 24 hour observation of the animals for bleeding is recommended. Once the bleeding has stopped turn the dehorned cattle out to pasture to avoid the dirt and manure of the confined pens and corrals.

15. APPLYING A FLY REPELLANT TO THE DEHORNING SITE - In fly season it is necessary to use some kind of fly repellant. Pine tar or a commercial repellant should be used. Check the wounds weekly until healed and repaint the repellant if necessary. If flys get into an open wound they will lay eggs which develops into maggots which will require other control methods. These controls usually consist of a wound dressing one of which is KRS manufactured by Cutter Laboratories.

In summary some of the important points to remember are: When at all possible dehorn at the youngest age. If older animals have to be dehorned - use proper equipment for the job, take precautions to minimize bleeding, use a fly repellant during fly season and remember to always clean and disinfect instruments after each use.

16. CREDIT SLIDE

Castrating Calves
Script for Slide Series

1. TITLE SLIDE - Since castration is the most commonly used and most widely accepted means of producing a desireable beef carcass from a male animal, it is one of the most common surgical procedures performed by the farmer or rancher. It is not a difficult or time consuming job, so most stockmen do it themselves instead of having it done by a veterinarian.

2. EQUIPMENT - Equipment needed for castration is very minimal and could consist of a sharp knife or scalpel only. In addition to the cutting instrument, many stockmen like to use an emasculator. This tool is used to crush and sever the testiclular cord to reduce the bleeding that could be caused by a sharp cut.

3. ONE MAN CASTRATING - The castrating of claves one to three days of age can be done very quickly and easily right out of the pasture. At this age it is possible for one man to hold the animal by sitting over the calf while performing the operation. After restraining the calf the lower portion of the scrotum is grasped with one hand and pulled out while the testicles are up in the scrotum. With a sharp knife the bottom 1/3 of the scrotum is cut off. When newborn calves are castrated out on clean pasture the use of a disinfectant is not required.

4. TESTICLES EXPOSED - After the lower portion of the scrotum has been removed the testicles can be exposed by pushing down on the scrotum.

5. PULLING TESTICLES OUT - After the scrotum has been pushed back so the testicles are exposed, grasp the testicle between the thumb and fore finger and pull it out.

6. RESTRAINING OLDER CALF - As calves get older the second person will be needed to restrain the calf. The hind legs of the calf can be held by an assistant and the front part of the calf restrained by the person doing the castrating.

7. DISINFECTING - As the animals become older it becomes increasingly important that suitable disinfectant be used. The scrotum should be washed liberally with a disinfecting solution prior to the operation.

8. CUTTING OFF LOWER 1/3 OF SCROTUM - By pulling down on the scrotum the lower 1/3 of the scrotum is cut off.

9. EXPOSED TESTICLES - By pushing back on the scrotum, the testicles contained in the membrane are exposed.

10. SLITING THE MEMBRANE - After the testicle is exposed, the membrane is cut by making a cut across the testicle.

11. CUTTING MEMBRANE - The membranes are then cut from the testicle.

12. SCRAPING THE CORD - On smaller calves the testicle and attached cords can be pulled out without any further use of the knife. As the animal gets older it may be advisable to scrape the cord with a knife to help prevent bleeding.

13. POSITIONING THE BURDIZZO PINCHERS - This is the Burdizzo pinchers. This method of castration is bleedless. The spermatic cord for one testicle is worked with your fingers to the side of the scrotum and the jaws of the Burdizzo is positioned so it will pinch one cord at a time.

14. CLAMPING THE BURDIZZO PINCHERS - Then clamp the Burdizzo on about 1 3/4 to 2 inches above the testicle, where it is held for a few seconds. Then repeat this operation on the same cord at a location about 1/4 inch above or below from the first one. Repeat the same procedure on the other cord.

15. LARGER RESTRAINED BULL - This bull is restrained and ready for castration. If possible and practical in your operation it may be desirable to castrate at a much earlier age.

16. GRASPING THE LOWER SCROTUM - To castrate this bull we will be cutting about 1/3 of the lower scrotum off. This is a way the scrotum can be grasped in preparation for this cut.

17. EXPOSED TESTICLES - This shows the exposed testicles after the lower 1/3 of the scrotum is cut off.

18. EMASCULATOR - The emasculator is often used on larger animals to crush the cord before cutting it off. This helps reduce bleeding that often occurs from a knife cut. Note the crushing jaw and the shearing jaw of the emasculator.

19. USING EMASCULATOR - The testicle is grasped and pulled so the emasculator can be clamped around the cord above the testicle. It is important to remember that the side with the crushing jaws of the emasculator are positioned toward the animal. The emasculator is then squeezed like a plier which crushes and cuts the cord.

If simple approved practices are followed a good job of castration will result with little chance of complications.

Sow and Small Pig Care
Script for Slide Series

1. TITLE SLIDE - The basic objective of any business is to operate as efficiently as possible. This holds true in the pork industry. The efficiency starts with proper sow or gilt management and carries through baby pig care. The problem, which hogmen spend thousands of dollars on, usually starts with improper sow feeding and care. This series of slides will attempt to show some important steps in efficient management of sows and gilts and on through the care of baby pigs.

2. RECORDS - Records on the sow herd should be a vital part of every hog enterprise. When we speak of records this includes breeding dates, farrowing dates, litter weights, weaning dates, and feed costs. To be able to do this there must be some kind of gilt and sow identification. There are many different types available from ear notching to various kinds of eartags.

3. PROPER FEED - Nutrition is probably one of the most important management tools of a hogman. By nutrution we mean a well balanced ration which meets all the requirements of any particular hog whether a sow, gilt, feeder or finisher. Anyway you look at it, feed represents the major cost of producing pork. Your dry or gestating sow should be limit fed so that she does not get too big or fat. Weight gains mean extra cost and problems. During gestation your sow will only need 4 to 6 lbs. of a well balanced ration. Increase feed for bred gilts or sows before farrowing. Animals should not be fed the day of farrowing and 24 hours afterwards. During lactation they can be fed free choice. If you don't feed free choice the sows should be getting 12# per day. When hand fed you have better control over your sow with those who have larger litters getting more and also holding back on those sows who are too fat.

4. TALKING WITH FEED MAN - Feed costs, being as high as they are today, you as a hog producer have the option of reducing those costs. One option is working closely with your feed man. He can work out a balanced ration with you. Most feed companies will test your feed for you. In the absence of a feed man send your sample to the State Laboratories. Have them test for protein, phosphorous and calcium. The protein requirements of gestating sows is 17%, where as the lactating sow requires only 15% protein. A 2:1 calcium phosphorous ratio is important in prevention of milk fever and zinc defficiency.

5. CLEAN PEN - Sanitation, whether it is in a barn or a modern confinement building, is a must. Have your pens or crates cleaned and disinfected before the sow or gilt is put in. A disinfectant recommended by veterinarian is Environ, but be sure to follow instructions.

6. SCRUBBING SOW - If possible the sow should be scrubbed with a mild soap and disinfectant. Sows should be put into the farrowing crate or pen three days before the pigs are to be born. This will give the sow a chance to get accustomed to her new surroundings. With older sows you can tell if they are getting close to farrowing by the full tight udder. But with gilts you will have to watch them very closely. The best would be to have breeding dates.

7. SOW WITH HEAT LAMP - Proper preparation is necessary before pigs are born. Have heat lamps set up and make it a point to be there when they are born. You can usually tell if the gilt or sow is going to farrow by her "nesting" tendency. She will be building a nest with the straw in the pen or just rutting around in the crate. The temperature for these newborn under the heat lamp area should be in the 95° range. Maintain this temperature 48 hours. Then hold heat lamp area at 85-90°F. After two weeks you can eliminate the heat lamps entirely. If you have heat in the floor, again they will be affected by weather conditions.

8. EQUIPMENT AND MEDICINE - Equipment that you should have ready before farrowing is as follows:

1. Roll of paper towels or clean clothes.
2. Side clippers
3. Ear notches
4. 7% iodine solution
5. Antibiotics of your choice and syringes
6. Iron (oral or injection)
7. Scour treatment

Every hog producer should have a vaccination program included in his management practices. For Erysipelis and Lepto the sows should be vaccinated at least every six months. Also in your program you should worm your sows twice a year. This could be Algard which is just added to the feed or Piperzine that you add to the water.

9. TREATING NAVEL CORD - Once these little pigs are born the navel or umbilical cord should be treated with a 7% iodine solution. The treatment seals off the cord to prevent micro-organism from passing up the cord.

10. CLIPPING LOWER NEEDLE TEETH - A very essential procedure which some hogmen neglect to do is the clipping of needle teeth, sometimes referred to as "eye teeth" or "wolf teeth". Each pig has eight needle teeth which should be removed. These are located on both the lower and upper jaw in pairs on either side. These teeth are very sharp and are the piglets main line of defense against his siblings. When the pigs are fighting for nipples they clash each other with these teeth causing lacerations which become infected and swollen. Needle teeth can be removed very successfully using a small pair of side clippers, which can be purchased at any hardware store.

11. CLIPPING UPPER NEEDLE TEETH - Each set of needle teeth can be removed or clipped in one motion. Thus, it is necessary to "clip" four times to remove all eight teeth. Be careful not to cut the gums of the little pigs. Again, these open cuts can cause infection.

12. DOCKING TAIL - Another procedure that is highly recommended for all pork producers is the docking of tails. The docking operation is done for the preventions of tail biting. The problem of tail biting in confinement swine rearing operations is great and could run into ecomonic losses. The actual docking should be done at as young an age as possible. If you do it within two or three days old you usually eliminate bleeding. Use a side clipper, good surgical scissors, or an emasculator. The side clipper you use to clip the needle teeth can be used very effectively to do both jobs. You should desinfect the side clipper between operations.

13. CUT TAIL - Leave about 1/4" stub. You can do the docking of the tail at the same time you are giving the iron shot. This decreases the number of handlings and reduces your labor.

14. TREATING WITH 7% IODINE SOLUTION - In all cases after the tail is removed the wound should be treated with a suitable disinfectant such as a 7% iodine solution.

15. ADMINISTRATING ANTIBIOTICS - The administering of antibiotics to the little pigs is one that every hog producer has to decide for himself if he wants to use them. The antibiotic is given to the newborn as just another preventative measure. There are various ways to administer antibiotics. The procedure which most hog producers are using is to give the antibiotic to the little pigs right after birth. The amount will vary depending on the antibiotic. As an example 1/2 cc to 1 cc Tylan, or 1 to 2 cc's Penstrep, or Terramycin is used. You can also give the sow a shot, which passes through her milk to the little pigs. The amount to administer to the sow will be given on the bottle of antibiotic. When giving the injection the best area on the small pig is behind either ear. A 16 gauge needle should be used and being no longer than

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1/4". Be careful not to jab the needle into the little pigs spinal column, which can cause serious injury or even death. Again disinfect and clean equipment after each job.

16. GIVING ORAL SCOUR - Probably the biggest area of death losses in little pigs is scours. But, every hog producer, regardless of size and ability is likely to have an outbreak of scours. A good manager will be right there with scour treatment before the problem has a chance to spread. Giving little pigs oral treatment at birth or at the first sign of scours is the best prevention. Many companies make a product that can be mixed in the feed to prevent scours.

17. GIVING ORAL IRON - Anemia in baby pigs can be a problem which requires some type of preventative measures. You can give either oral or injectable iron. Most hogmen find that the injectable iron is a sure thing where as the oral treatment the little pigs seem to spit it out. The iron shot should be given at two to three days of age. A lot of the confined hog producers are giving a booster shot from 10 to 14 days after the first shot. Another method of anemia treatment is placing sod in the crate, be sure it is clean and not taken from present lots so you do not infect the newborn with worms and erysiplieas.

18. GIVING INJECTABLE IRON - The injectable shot can be given behind the ear or in the ham area. Most hog producers are giving the shot behind the ear because giving it in the ham can cause lameness and then they are more apt to get stepped on. Regardless of the area, be sure you disinfect your needle between each use so you don't cause infection.

19. EAR NOTCHING - Ear notching is a good permanent way to identify pigs and should be used in all herds whether commerical or purebred. There are several different types of systems and the Purebred Associations recognize only cer-

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tain systems, but the commercial producer can use any system whichever works best for his own operation. For various types of notching systems check any hog production book.

20. FINISHED JOB - The ear notching job should be done at as early an age as possible. This again will eliminate most of the bleeding. Quality of job vs age will not have any effect, you will be using just a bigger notcher.

21. CASTRATION - Castration of the piglet can be accomplished at any age, but ease of handling and minimizing stress on both the pig and the handler dictates that the earlier in the pigs life that this procedure is done the better. There are many different ways of restraint to remove the testicles. They will have there advantages and disadvantages for beginners. The best approach is to try the various methods and use the one which you find is the easiest. Just remember, care should be taken in all cases to keep contamination to a minium and to avoid infection.

22. WEANING PIGS - Weaning of the litter can be done at almost any time. Some big confinement operations are doing it at three days. In years past the litter was weaned at five to six weeks old. Now most hog producers are finding that weaning at 21 days old, the pigs weighing 12 to 15 pounds, the sows are ready to be bred back and will come into heat within four to five days after weaning. If you do have some smaller pigs put them on one sow held back in the crate, more or less as a nurse sow. Be sure the sow is content and gentle.

23. VETERINARIAN - Another important person not mentioned yet is your local veterinarian. Work with him if you have problems. The bigger confinement operations are hiring the veterinarian to do all vaccinations and just give your herd a periodic health check. Maybe for the smaller operator the hiring of the veterinarian once or twice a year could eliminate many problems associated with the pork industry, of which there are many.

24. SUMMARY - In summary, sow management as well as baby pig care is probably the most demanding of your labor and management. It takes a good operator to raise feeder pigs. The records of good management are not only monetary, but can give the satisfaction of a job well done. The management ideas which have been discussed in this slide presentation are too often overlooked. Any swine producer who is interested in increasing the profit margin of his operation should seriously consider implementing any of these prodecures which he is not presently using. A brief list of procedures in good management:

SOWS

1. Proper nutrition
2. Identification and records
3. Clean pens and sows
4. Good breeding stock

BABY PIGS

1. Provide heat lamp
2. Be there at farrowing, when possible
3. Treat navel cord
4. Clip needle teeth
5. Give an antibiotic shot
6. Dock tail
7. Give oral scour
8. Give iron shot
9. Ear notch
10. Castrate

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ABSTRACT: COVERING THE TIME PERIOD OF JULY 1974 TO JUNE 1975, THIS REPORT DESCRIBES THE SECOND YEAR ACTIVITIES OF A COMPREHENSIVE CAREER EDUCATION PROGRAM IN THE DES MOINES SCHOOLS. INCLUDED AMONG THE VARIOUS COMPONENTS OF THE PROJECT WERE: CAREER EDUCATION AT THE ELEMENTARY, JUNIOR HIGH, AND SENIOR HIGH LEVELS; CAREER EDUCATION FOR THE HANDICAPPED AND FOR THE SCHOOL DROPOUT; VOCATIONAL GUIDANCE, PLACEMENT, AND FOLLOWUP; VOCATIONAL YOUTH ORGANIZATIONS; CAREER INFORMATION; AND STAFF DEVELOPMENT. DURING THIS YEAR CAREER EDUCATION WAS EXPANDED AT THE ELEMENTARY AND JUNIOR HIGH SCHOOL LEVELS, AND THE INITIAL PLANNING FOR IMPLEMENTING CAREER EDUCATION AT THE SENIOR HIGH LEVEL WAS ACCOMPLISHED. THE PROJECT STAFF PRESENTED THE PROGRAM AT VARIOUS PROFESSIONAL AND INSERVICE MEETINGS THROUGHOUT THE MIDWEST. THE ACCOMPLISHMENTS OF EACH OF THE PROJECT COMPONENTS IS BRIEFLY REPORTED. NEWSCLIPPINGS RELATING PROJECT ACTIVITIES ARE INCLUDED IN THE APPENDIX. (NJ)

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COMPREHENSIVE CAREER CURRICULUM

Des Moines Independent Community School District

DES MOINES, IOWA

VT 102 519

INTERIM REPORT

Project Number F7137VW
Grant Number OEG-0-73-5280

COMPREHENSIVE CAREER CURRICULUM

Exemplary Project in Vocational Education
Conducted Under
Part D of Public Law 90-576

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INTRODUCTION

This interim report covers the second project year from July 1, 1974 to June 30, 1975.

The following information in this report is presented by the various components of the project. The components are:

1. Career Education - Elementary Schools
2. Career Education - Junior High Schools
3. Career Education - Senior High Schools
4. Vocational Education - Technical High School
5. Handicapped Career Center
6. Career Education for School Drop-Outs
7. Career Guidance Services
8. Career Placement and Follow-Up
9. Vocational Youth Organizations
10. Staff Development
11. Career Information
12. Post Secondary Career Training
13. Frederick Douglass Learning Center
14. Evaluation

The component on staff development will be discussed within the other components and not discussed separately. In this report the progress regarding project evaluation is discussed separately rather than within each component.

During the second project year career education was expanded at the elementary and junior high level and the initial planning for implementing career education at the senior high level was accomplished. Good progress was made in several of the components indicated above while progress in some was limited because of circumstances discussed in the previous quarterly reports.

During this year the elementary and junior high schools not presently involved in career education were contacted, building coordinators identified, and the initial planning for these new schools took place.

The project staff has been invited to present Des Moines' career education program at various professional and in-service meetings throughout the middlewest. As a result of these presentations there has been requests from educators at all levels for the curriculum materials developed by the Des Moines teachers. Because of the quanity of requests the Des Moines district has had to ask that the postage be paid by the individuals requesting the material.

In reviewing the overall progress made during the second project year the staff feels that in general the progress has been good and that principals, instructors, administrators, and the community have been actively involved and supportive of the implementation of career education in the Des Moines Schools.

I. ELEMENTARY COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

An elementary career education specialist was hired during this year. She provided in-service for the forty-two schools implementing career education this year and to the remaining fifteen schools that will enter the project in the fall of 1975.

The elementary slide presentation was shared with several schools, all the elementary principals, several P.T.A.'s, the Chamber of Commerce, classes at Drake University and various other local and state community groups.

A hundred teachers attended a three hour career education session on the staff development day in February. A fifteen hour staff development course, Designing Instructional Materials for Career Education, was taught by the curriculum specialist.

Building coordinators met once each month by sections. New building coordinators for the 1975-76 year were selected as well as steering committees for the fifteen new schools.

A committee planned the summer workshop to write the final revision of the elementary handbook. A questionnaire to evaluate the handbook was sent to each building. The data was collected and plans for revision were made.

A team of teachers planned the three day summer workshop for the fifteen new schools. A two day summer workshop for the fifty-five building coordinators was also planned.

Instruments for evaluating career awareness and self awareness were written and administered. Results of the evaluation will be included in the third party evaluator's report.

2. SIGNIFICANT FINDINGS OR RESULTS

The building coordinator structure that was used this year has proven to be very successful. It has aided in keeping 1000 elementary teachers informed about career education. (see figure 1)

Schools coming into the project during the 1975-76 school year have been very responsive to the career education concept. Some of the schools have already had several meetings to begin planning for implementation.

Evaluation of the handbook was very positive. Teachers have found it to be a useful tool anddid not want anything deleted from it but did have some suggestions for additional material to be included.

3. PROBLEMS

The position of Elementary Career Education Curriculum Specialist was vacant until January 1, 1975. This created extra responsibilities for the project director prior to that date.

ELEMENTARY CAREER EDUCATION SECTIONS

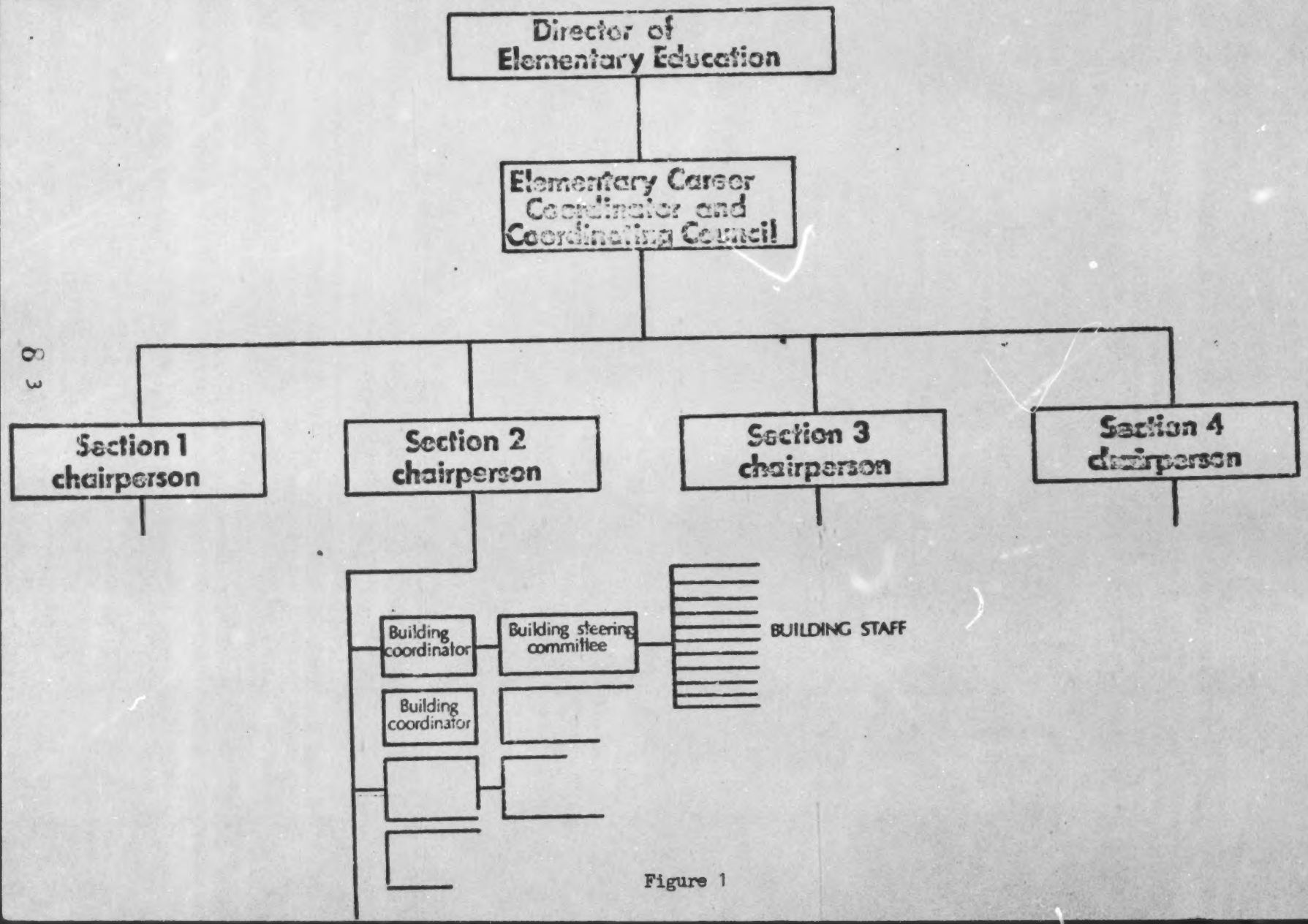


Figure 1

4. DISSEMINATION ACTIVITIES

Elementary Career Education Handbooks have been distributed to all elementary teachers. It has also been sent to many educators throughout Iowa and the United States who have requested it.

Career education has received good coverage in the Des Moines Register and Tribune. See Appendix A, B, C, D, and E for articles appearing during the fourth quarter.

5. DATA COLLECTION

Career awareness and self awareness progress was evaluated and the results will be presented in the third party evaluator's report.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

See evaluation component in this report for progress of third party evaluators.

7. OTHER ACTIVITIES

Five schools and businesses were visited and business/education alliances were established.

8. STAFF UTILIZATION

See section 1 for the curriculum specialists activities during this year.

9. FUTURE ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD

Future activities planned for the elementary component are:

1. Revision of elementary handbook.
2. Planning of a three day workshop for teachers and principals new to career education.
3. Planning of a two day workshop for building coordinators.

II. JUNIOR HIGH COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

The six additional junior highs involved in implementing career education during this project year progressed at a greater pace than the three original junior highs that were involved during the first project year.

This progress was due to several factors with perhaps the following two items having the most impact.

1. The structure developed at this level identifies a building coordinator from each school. Monthly in-service meetings were conducted with agendas me[illegible] the needs of the coordinators and their instructors.

2. The involve[illegible]of the district office supervisors with their respective instructors [illegible]nd the "road map" developed during the preceeding year regarding purchasing procedures, in-service needs, etc. aided progress.

The four junior high curriculum workshops during the first quarter of this year developed curriculum materials in additional occupational clusters which enables the junior high instructors to have access to curriculum materials in thirteen of the fifteen occupational clusters. In 1973 when the teachers started to develop curriculum materials there were commercial materials developed on three occupational clusters. To date Des Moines teachers developed curriculum materials in ten other clusters and have incorporated a variety of current commercial material. The only two clusters that do have curriculum materials are Personal Services and Marine Science.

Upon the recommendation of the General Advisory Committee for Career Education articulation plans were developed and implemented with several junior highs and their feeder elementary schools.

Several activities not specifically identified in the project but some of which are indicated in this year's quarterly reports supplemented the career education activities planned by the instructors. The majority of these activities were planned, developed and implemented by community members or groups other than educators.

2. SIGNIFICANT FINDINGS OR RESULTS

The majority of the junior high teachers have readily accepted career education and are taking part in the implementation of it in their buildings. It was found the monthly meetings of the building coordinators provided the various instructors an opportunity to share and gain additional insights in implementing career education activities in their classrooms. Also the involvement of the community in career education has provided the instructors with additional resources to draw upon as well as indicating to the instructors the support that career education has outside the education community.

3. PROBLEMS

There were no major problems in working with the junior high staffs in implementing career education during this project year. However during the fourth quarter the purchasing office developed a new purchase requisition form and required all schools to use this form during the last two months of school. This created some minor problems with the various junior highs and was one of the topics of the monthly coordinators' meetings.

Since the project involves curriculum development there are some additional secretarial needs that have caused concern during the first as well as the second year of the project. Because of these additional secretarial needs the junior high health curriculum materials developed in the first quarter of this project year were not completely typed, proofread, printed and distributed.

4. DISSEMINATION ACTIVITIES

All of the junior high curriculum material that was developed and printed was distributed to all of the respective junior high instructors. Each elementary and senior high school building also received copies of the material. The curriculum material developed in this component also was distributed upon request to other districts in this country and England.

Several newspaper articles appeared in the local newspapers as shown in previous quarterly reports. See Appendix F&G for articles that have appeared during the fourth quarter of this project year. Numerous articles also appeared in the various school newspapers of which copies were not always forwarded to the project office.

5. DATA COLLECTION

The only formal data collected during this project year pertaining directly to the project was a sampling of the students and all the junior high teachers regarding the Career Information Center (CIC).

Other data was collected from the students that was part of past activities. This data includes:

1. Career Interest Survey (see Appendix H)

2. Youth Employment Survey (see Appendix I)

During the project year the junior high building principals were requested to complete data on certain items that pertained to the implementation of career education in their buildings.

See the evaluation component in this report for specific infomation on the student and teacher evaluation of the CIC's.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

The progress in this component is as scheduled with the remaining five junior high schools to become involved in career education next year.

With the identification of the building coordinators during the fourth quarter of this project year and the monthly coordinators meetings that they attended, some of the initial planning and development has been completed. Thus it is hoped the implementation will take place early in the 1975-76 school year.

See Evaluation Component in this report for progress of third party evaluators.

7. OTHER ACTIVITIES

Several other activities occurred during this year which involved the total community and discussed in previous quarterly reports. Without repeating some of this detail the major activities are listed below:

1. General Advisory Committee for Career Education reviewed progress of career education at junior high level.

2. Business/Education Alliance - three active alliances continued to operate during this school year with four additional junior highs requesting to participate in the alliance program.

3. Career Expo 75 - cooperated with West Des Moines Jaycees in planning and implementing Career Expo '75.

4. Des Moines Club of Printing House Craftsman's Tours - day long field trips for students in communication and media activities. Tours arranged and set up by Craftsman Club.

8. STAFF UTILIZATION

Since there was no direct project staff in this component paid with project funds, the Coordinator for Career Education for the district (project director) and the central office education supervisors were responsible for the implementation of career education at this level.

The elementary career education curriculum specialist assisted the project director with ideas on implementing career education with junior high students and articulating career education in the elementary and junior high schools.

9. FUTURE ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD

Future activities planned for the junior high component are:

1. Type revised curriculum materials
2. Print these materials
3. Distribute these materials
4. Meet with building coordinator chairperson and plan monthly coordinators meetings for 1975-76

III. SENIOR HIGH COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

The planning and implementation of career education in this component during this project year got off to a slow start but progressed well during the last two quarters.

During this project year building coordinators and steering committees were identified at East and Roosevelt high schools. These committees looked for career education curriculum materials related to their students interests during the first two quarters. Each building then accessed what their instructors were presently doing in career education and identified the goals and objectives for their schools. Instructors were asked to participate in a curriculum workshop during the summer of 1975. Some of the workshop time was conducted prior to July 1, 1975 with some time being identified after July 1, 1975 to meet the teachers schedules at the two schools.

Meetings were conducted with several senior high principals and businesses to strengthen some of the existing Buxiness/Education Alliances.

2. SIGNIFICANT FINDINGS OR RESULTS

The instructors in the two senior high schools realized that there was a limited amount of existing material in career education for high schools.

The steering committees in each school have been active in the planning and organizing of career education in their schools.

The curriculum workshops were organized and started during this project year with good progress being made prior to July 1, 1975.

3. PROBLEMS

Because of the nature and philosophy of the two senior high schools the progress of planning, developing and implementing career education has been slow.

Another factor that has had some effect on the progress at this level has been the continued effort to articulate career education at the senior high level to what has been accomplished at the elementary and junior high level.

The final philosophy and direction of career education in the two schools is somewhat different, however, the overall objectives are similar. Each steering committee knew the needs and interests of their faculties. The final philosophy was identified by the steering committees and based on the needs, interests, and desires of their faculties.

4. DISSEMINATION ACTIVITIES

The disseminating activities that took place during this project year were somewhat general in nature as discussed in previous quarterly reports. It is planned that the materials that have been developed by the instructors in the workshops will be typed, printed, and presented to the other staff in the respective schools early in the fall of 1975.

See Appendix J & K for newspaper articles.

5. DATA COLLECTION

The only formal data collected during this project year pertaining directly to the project was a sampling of the students and all the senior high teachers regarding the Career Information Center (CIC).

Other data was collected from the students that was part of past activities. This data includes:

1. Career Interest Survey (see Appendix H).

2. Youth Employment Survey (See Appendix I).

During the project year the senior high building principals were requested to complete data on certain items that pertained to the implementation of career education in their buildings.

See the evaluation component in this report for specific information on the student and teacher evaluation of the CIC's.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

The progress in this component has not followed the implementation plan identified in the original project. Because of the delay in the start of the planning in this component plus the additional delay in the development of the curriculum, the actual implementation is approximately one project year behind schedule. However, as stated earlier in this component good progress is now being made.

See the evaluation component in this report for progress of third party evaluators.

7. OTHER ACTIVITIES

Several other activities occurred during this year which involved the total community and discussed in previous quarterly reports. Without repeating some of this detail the major activities are listed below:

1. General Advisory Committee for Career Education reviewed progress of career education at senior high level.

2. Business/Education Alliances continued to operate this school year with three additional existing alliance programs being reviewed and assistance given to strengthen the programs.

3. Career Expo 75 - cooperated with West Des Moines Jaycees in planning and implementing Career Expo '75.

8. STAFF UTILIZATION

Since there was no direct project staff in this component paid with project funds, the Coordinator for Career Education for the district (project director) and the central office education supervisors were responsible for the implementation of career education at this level.

The elementary career education curriculum specialist assisted the project director with ideas on implementing career education with senior high students and articulating career education in the elementary, junior high, and senior high schools.

9. FUTURE ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD

Senior high career education future activities include:

1. Typing curriculum materials developed in summer workshops.

2. Print these curriculum materials.

3. Develop and implement plans for acquainting other senior high teachers with materials.

IV. TECH HIGH COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

Practical Nursing

The curriculum was approved by the Iowa Board of Nursing on contingent of the students' success in taking their state exams this fall.

Summer school plans were made for refresher activities for the nursing students. Part of the summer school program was implemented prior to July 1, 1975.

During the last quarter of this project year the coordinator of this program resigned to accept a position as head of the nursing program at the local community college. The district advertised, interviewed and employed a replacement for the coordinator.

Agri-business

This program was implemented during this project year with one program at Tech High and the other at McCombs Junior High. Two instructors were employed July 1, 1974, on twelve month contracts. They started to plan their curriculum in detail during the summer and visited with parents and students interested in the program.

During the year the open house was held at both schools with the Agri-business programs having good student displays. An FFA chapter was chartered for the Des Moines Schools and the students got actively involved in the planning and

implementing of chapter activities.

Facility and staff needs for the program for 1975-76 were discussed and several plans were developed and submitted for review and approval. The Agri-business advisory committee played a large role in these plans and recommendations.

Applicants were interviewed for an additional instructor's position and the McCombs site was identified as the location for the junior and senior high agriculture programs with some type of temporary structures being developed on the site to accomodate both programs.

2. SIGNIFICANT FINDINGS OR RESULTS

The existing student interest in both programs appears to be high and there is also a large amount of interest among junior high students regarding these programs.

The instructors in both programs have accepted the leadership in the promotion and development of their programs.

The Iowa Board of Nursing and the Agri-business community continues to support and play an active role in these programs.

3. PROBLEMS

With the uniqueness of these two programs the district was somewhat unaware of the specific needs of both programs. This may have caused some frustrations with the instructors but with good planning and community support the programs and facilities have been developed this year with plans to meet the program needs for 1975-76.

4. DISSEMINATION ACTIVITIES

Various articles as indicated in the quarterly reports have been printed in the local and school newspapers regarding both programs. See Appendix L for articles appearing this quarter.

Because of the contacts made by the program coordinators with junior high students, the interest and enrollments in the Practical Nursing program has increased sharply as has the junior high interest in the Agri-business program.

5. DATA COLLECTION

None done formally.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

See Evaluation Component in this report for progress of third party evaluators.

7. OTHER ACTIVITIES

Students in these two programs have participated in state and national meetings of their respective Vocational Youth Organizations. Students in these programs have also participated in local and state association meetings in their areas.

The coordinator for the practical nursing program spoke to the Health Occupations Teachers in Iowa at their state conference during the fourth quarter and explained Tech's program and objectives.

There have been several other Tech activities that have received recognition but are not directly a part of this project and are not included in this report.

8. STAFF UTILIZATION

For the 1974-75 school year no project funds are budgeted for this component.

9. FUTURE ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD

Tech High career education future activities include:

Practical Nursing

1. Complete summer school refresher course.
2. First graduating class will take their state exams.

Agri-business

1. Employ an additional Agri-business instructor for Tech.
2. Finalize and implement facility plans at McCombs.
3. Order materials needed for second year of program.
4. Contact parents and students signed up for sophomore program.

V. HANDICAPPED COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

Because of the recent legislation creating Area Education Agencies (AEA) in Iowa and the uncertainty of who would be responsible for the administration of special education programs, the progress in this component was at a standstill during this project year.

Initial contacts were made and plans were developed for including Van Meter school for mentally retarded students and Smouse school for physically handicapped students in the elementary component for 1975-76.

A separate proposal was written and submitted to the USOE, Career Education Department for funding. This project involved in-service of teachers and curriculum development. This project was not funded.

It appears that with the formation of the AEA that the vocational objectives stated for this component in the original proposal will actually be material to correspond with the elementary and junior high objectives of career awareness and exploration.

VI. SCHOOL DROP-OUT COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

During this project year a new coordinator for Greater Des Moines Educational Center (GDMEC) was identified. The individualized typing program and the equipment for it was ordered and installed with students utilizing the equipment this year.

Other career education software items were identified by teachers and purchased during this year.

Teachers continued to plan and develop objectives and activities in their subject areas relating to career education with the majority of the development being done during the summer of 1975.

The work-experience phase of the GDMEC program has been implemented and expanded to accomodate more students.

2. SIGNIFICANT FINDINGS OR RESULTS

When some of the various funding sources involved in this program for this year stopped funding the GDMEC, the district had to plan in their 1975-76 budget additional funds for the center.

3. PROBLEMS

During this project year the remodeling of the second facility for the GDMEC has been moving somewhat slowly, expecially in the industrial arts area. Much of the equipment ordered for this area with other funds has been slow in arriving.

The instructors were not able to identify times during the year to complete all of their curriculum development but have identified times during the summer to complete their curriculum development.

4. DISSEMINATION ACTIVITIES

Since the instructors have not completed integrating career education into their subject areas this project year, there has been no dissemination of their materials.

5. DATA COLLECTION

None done formally.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

See Evaluation Component in this report for progress of third party evaluators.

7. OTHER ACTIVITIES

The GDMEC received additional funds from the State Department to assist in purchasing equipment for their program areas.

The GDMEC students visited again this year the Career Expo sponsored by the West Des Moines Jaycees.

8. STAFF UTILIZATION

There is no staff in the project for this component.

9. FUTURE ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD

School Drop-out career education future activities include:

1. Continue in-service for instructors at GDMEC.
2. Receive copies of materials developed by GDMEC instructors
3. Instructors review evaluation guidelines and format for objectives in this component.
4. Identify materials to assist instructors in implementing career education activities.

VII. CAREER GUIDANCE SERVICES COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

Tech Brochures

Brochures have been planned, developed and printed for the following vocational programs.

1. Accounting
2. Auto Body
3. Automotive
4. Architectual Drafting
5. Machine Drafting
6. Industrial Electricity
7. Radio Television

See Appendix M, N, O, P, Q, R, and S for copies of these brochures.

Career Information Centers (CIC)

During this year an additional six junior high schools along with the original three junior highs and two senior highs developed and continued to develop Career Information Centers.

The librarians, counselors, and instructors had imput into the purchasing of materials for the centers.

Because of facility limitations in some of the junior high schools the location of the centers vary as indicated in the second quarter report. Because some of the centers in the six junior highs have been in the process of being established

this project year, the CIC's have not been reviewed in relation to the specific location and the effectiveness of the center.

2. SIGNIFICANT FINDINGS OR RESULTS

Career Information Centers

During this project year many of the schools as they reviewed and purchased specific items for the centers have found that some items recommended by the various instructors could best be ordered and located in the CIC in order to accomodate more students. In review of the expenditure of funds during the fourth quarter, it was noted that funds needed to be transferred from the material account in the junior high component to the material account in this component to allow for this action on the part of the instructors.

3. PROBLEMS

During this year the planning and implementation of the CIC proceeded very well. The schools organized their centers early and started purchasing materials early in this project year. The only area of difficulty was the fact that in some schools some instructors, counselors, and librarians went over their budget for materials in this component.

4. DISSEMINATION ACTIVITIES

During the year the project staff forwarded to each of the CIC's copies of catalogs and literature appropriate for use in the center. Various salespeople were also referred to the counselors and librarians in each CIC.

At one of the early meetings of the junior high building coordinators for career education, the counselors and librarians discussed and shared with the group the operation of the CIC in their school.

5. DATA COLLECTION

During the year instruments were developed and reviewed to evaluate the center. This evaluation was for students and instructors. During the fourth quarter the evaluation was conducted and the evaluation data collected.

See Evaluation Component in this report for progress of third party evaluators.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

The evaluation of this component was conducted during the fourth quarter, with the data being collected and submitted to our third party evaluators. The results of this evaluation will appear in the final report of this year written by our third party evaluators.

7. OTHER ACTIVITIES

Career Expo was planned and conducted through the cooperation of the counselors in the secondary schools.

In those secondary schools with active Business/Education Alliance programs, the guidance staff played a large role in working with this program.

The need for and objectives on information regarding the development of materials on employability skills was identified and discussed this year. Senior high teachers were selected from six different subject areas to work in a workshop this summer to develop materials in this area.

8. STAFF UTILIZATION

There is no staff in the project for this component.

9. FUTURE ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD

The Future activities for Career Guidance include:

1. Discuss CIC's with the building coordinators for the five new junior high buildings.

2. Plan early fall workshops for building coordinators regarding the function, use and operation of CIC's.

3. Conduct workshop on employability skills.

4. Type materials developed in employability skills workshop.

VIII. CAREER PLACEMENT CENTER COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

The placement of the June, 1974 graduates seeking assistance was continued into the first quarter of this project year.

The Rent-a-Kid program was continued this project year on a year around basis.

January graduates seeking assistance were helped in their placement needs.

An employment survey was administered to a sample population of secondary students. This survey was given, results were tabulated and the information distributed to the administrators and counselors.

The placement center staff identified and assisted in the identification of needs and the topics for an employability skills workshop.

2. SIGNIFICANT FINDINGS OR RESULTS

In reviewing the summation of all the statistics during the past year on placing students either into the world of work, military, or continuing education, the following results were noted as compared to other years. (See figure 2.)

ITEM	1971-72	1972-73	1973-74	1974-75	TOTAL
		JOB OPENINGS			
Full-Time	542	524	396	406	1,868
Part-Time	304	965	638	755	2,662
Rent-A-Kid	986	2,747	1,556	1,498	6,787
	1,832	4,236	2,590	2,659	11,317
		APPLICANTS REFERRED			
Full-Time	411	471	350	547	1,779
Part-Time	479	1,462	924	1,255	4,120
Rent-A-Kid	897	2,245	1,396	1,593	6,131
	1,787	4,178	2,670	3,395	12,030
		APPLICANTS PLACED			
Full-Time	287	178	135	137	737
Part-Time	268	572	360	275	1,475
Rent-A-Kid	861	1,758	1,185	1,400	5,204
	1,416	2,508	1,680	1,812	7,416

Figure 2

3. PROBLEMS

In reviewing the data that is requested and available at the center, the figures only reflect those part-time and full-time students placed by the center. During 1972-73 the center operated six different satellite centers during the summer primarily for Rent-a-Kid. Then during 1973-74 the number of centers were reduced to four and for 1974 there was only one center in operation.

During the last quarter of this project year the placement specialist left the program to become self employed. This leaves only the director and one secretary.

4. DISSEMINATION ACTIVITIES

During the project year the Career Placement Center staff visited the secondary schools and the youth employment counselors each quarter and discussed the placement needs for that quarter.

Billboards, radio, and TV was used in promoting the various efforts of the center at times that were most convenient for the students. Some of this advertising was paid for while some was public service announcements. (See Appendix T)

5. DATA COLLECTION

The employment needs survey that was conducted during this project year was tabulated and distributed to the central office administrative staff, building principals and counselors.

Monthly statistics are kept regarding the number of job openings, the number of referrals, and the number of placements.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

See Evaluation Component in this report for progress of third party evaluators.

7. OTHER ACTIVITIES

There were no other major activities during the year in this component.

8. STAFF UTILIZATION

There is no staff in the project for this component. See section 1 of this component for additional information regarding the staff in this component.

9. FUTURE ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD

Career Placement Center future activities include:

1. Continue to operate and place full time, part time, and Rent-a-Kid students from those students seeking these services.

2. Continue to place 1974-75 graduates.
3. Coordinate employability skills workshop.
4. Review the placement data during this next school year and offer a staff development program in this area.

IX. VOCATIONAL YOUTH ORGANIZATION COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

The activities during this project year for this component consisted of distributing to various instructors and building principals the guidelines for Vocational Youth Organizations that were developed during the summer of 1974.

A presentation was made to the secondary principals regarding the guidelines as they were initially distributed and how they might be best used.

During this year these guidelines have assisted vocational instructors in working with students in regard to vocational youth organizations.

2. SIGNIFICANT FINDINGS OR RESULTS

The enrollment in vocational youth organizations has increased this year. The exact figures will be included in the third party evaluator's second report.

During the year the demand for copies of the guidelines from other states and the U.S.O.E. has been tremendous. The Iowa State VICA advisor has sent copies of this material to other advisors in Iowa.

3. PROBLEMS

As the result of the distribution of the guides, there needs to be a coordinated staff development session that would familiarize teachers with the materials in the guide and allow them time to develop activities in relationship to their own clubs.

4. DISSEMINATION ACTIVITIES

See section 1 of this component for comments on dissemination.

5. DATA COLLECTION

The only data collected at this time was the number of students enrolled in vocational youth organizations.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

See Evaluation Component in this report for progress of third party evaluators.

7. OTHER ACTIVITIES

The Greater Des Moines Chamber of Commerce assisted the district in printing the vocational youth organization brochures and then distributed the brochures to some of their members.

8. STAFF UTILIZATION

There is no staff in the project for this component. Existing central office vocational supervisors and vocational teachers will be utilized in this component.

9. FUTURE ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD

Future activities for vocational youth organizations include:

1. Planning and initiating a staff development program to familiarize teachers

X. STAFF DEVELOPMENT COMPONENT

This is written into the other components.

XI. CAREER INFORMATION COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

The narrated slide presentation on career education at the elementary level that was started during the first project year was completed.

A junior high narrated slide presentation has been started during this project year. All the slides have been shot and roughly edited. A junior high language arts teacher has been employed by the district to write the script and it is anticipated that the slide presentation will be completed early in the first quarter of the third project year.

2. SIGNIFICANT FINDINGS OR RESULTS

The person presently employed by the district in the media center has the necessary technical skills to complete the narrated slide presentation and to do an outstanding job with it.

3. PROBLEMS

With the employment of a new Director of School and Community Relations, the original project objectives were reviewed in light of the funds budgeted.

It was agreed that the junior high presentation should be developed and plans for a senior high presentation should be initiated.

Because of the additional workload that the administration placed on the media center to prepare visuals regarding integration plans for the district, the time

spent on the junior high slide presentation was reduced. However, our deadline for the finished copy was the first quarter of the third project year.

4. DISSEMINATION ACTIVITIES

The project director and staff had the opportunity to present career education in Des Moines to approximately twenty community groups within Des Moines and approximately twelve other teacher and professional groups from around the United States. When ever possible the elementary slides were shown. The response from the audience regarding the slides was excellent.

5. DATA COLLECTION

No formal data was collected other than a rough estimate regarding the number of people who heard the presentations. The number of people reached directly by the presentations was approximately 1500.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

See Evaluation Component in this report for progress of third party evaluators.

7. OTHER ACTIVITIES

See section 1 and 4 of this component.

The project staff during the third and fourth quarter of the project year developed and submitted a project to the Department of Career Education in the U.S.O.E. titled "Improving Communications of Career Education in Des Moines." This project was approved during the fourth quarter of the second project year.

In reviewing the new federal project budget and the budget for this component, funds may be transferred from this component.

8. STAFF UTILIZATION

There is no direct project staff involved in this component. However, funds are available to contract with an individual or agency that has the necessary expertise to complete the objectives of this component.

9. FUTURE ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD

Career Information future activities include:

1. Finalizing the script for the junior high slide presentation.
2. Finalizing the total slide presentation for junior high schools.
3. Do some initial planning of senior high slide presentation.

XII. POST SECONDARY CAREER TRAINING COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

During this project year Des Moines Area Community College (DMACC) instructors and Des Moines Public School instructors met and developed "challenge exams" in four subject areas:

1. Electricity/Electronics
2. Data Processing
3. Food Service
4. Marketing and Distribution

The goals of this component would allow Des Moines students in these four (4) areas an opportunity to do one or more of the following:

1. Complete their DMACC program at an earlier date.
2. Take a lighter course load at DMACC and work to help pay their college expenses.
3. Take more electives at DMACC and possibly graduate with both an Associate of Applied Science and Associate of Applied Arts degrees.

Instructors at both levels field tested these exams during this past year with results being available during the first quarter of the third project year.

Meetings were held with DMACC staff and Des Moines Public School staff to plan for the development of additional exams during the summer of 1975. The areas identified are:

1. Electricity/Electronics (additional exams)
2. Calculus
3. Marketing and Distribution (additional exams)
4. Food Service (additional exams)
5. Accounting

The instructors met and determined the most appropriate times for them to meet and work during the summer. These dates again were scattered all through the summer.

2. SIGNIFICANT FINDINGS OR RESULTS

Electricity/Electronics and Food Service tested students this year with the exams they developed. Food Service used the exams on a pre and post test basis.

3. PROBLEMS

Because of a need to develop a common format and the lack of available time for the project staff to completely final edit the material, it was not printed in final form.

4. DISSEMINATION ACTIVITIES

Because the material was not finished in final form the only dissemination was to the instructors who actually worked on the development of these exams.

This did provide these instructors with an opportunity to field test these exams.

5. DATA COLLECTION

The results of the student scores on the exams will be tabulated and included in the first quarter report for the third project year.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

See Evaluation Component in this report for progress of third party evaluators.

7. OTHER ACTIVITIES

The Executive Director for Secondary Education and the project director were the guests of the DMACC at a National Association of Junior and Community Colleges meeting. The theme of the meeting was articulation between secondary schools and community colleges.

8. STAFF UTILIZATION

The funds in this component paid for the extra time that the instructors spent in developing these "challenge exams".

9. FUTURE ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD

Post secondary career training future activities include:

1. Completing the typing and printing of the material developed during the summer of 1974.
2. Obtain test results of students who took the "challenge exams".
3. Conduct workshops.
4. Review, type, and print the materials developed during the summer of 1975.

XIII. FREDERICK DOUGLASS LEARNING CENTER COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

With carry over funds identified from the first year of the project this new component was developed.

The objective of this component was to provide funds for a workshop for the staff to integrate career education activities into their existing subject areas and then provide a limited amount of funds for the purchasing of materials.

During the first quarter the staff completed their workshop and started to identify and order materials they had identified.

2. SIGNIFICANT FINDINGS OR RESULTS

The staff in this program went right to work during the summer of 1974 and integrated career education into their lesson plans.

Early in the second and third quarters of this project year they previewed and ordered materials to implement their objectives.

3. PROBLEMS

This component was inadvertently omitted in the 1975-76 budget request. At the present time there appears to be no other major problems.

4. DISSEMINATION ACTIVITIES

All existing junior high career education curriculum materials were shared with the instructors in this component. Materials that the instructors at the center developed were shared internally with other instructors in the program.

5. DATA COLLECTION

During this project year no formal data was collected.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

See Evaluation Component in this report for progress of third party evaluators.

7. OTHER ACTIVITIES

No major activities occured.

8. STAFF UTILIZATION

There is no project staff identified for this component. The teachers in this program have been provided funds for in-service during the summer for integrating Career Education activities in their lesson plans.

9. FUTURE ACTIVITIES

Frederick Douglass Learning Center future activities include:

1. Implementing career education activities developed in summer of 1974.
2. Evaluate these activities.
3. Identify and purchase materials to help implement career education activities.
4. Identify someone from this program to meet monthly with the junior high building coordinators.

XIV. EVALUATION COMPONENT

1. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

The first year evaluation report from the third party evaluators was completed and sent to the project director.

During the first quarter word was received not to send out RFP to third party evaluators because some guidelines were forthcoming from the U.S.O.E. During the second quarter their was a meeting in Kansas City of all project directors in this region to review the evaluation guidelines. RFP went out late in the second quarter and EPIC was selected as our third party evaluators from four responses.

During the third and fourth quarters the project staff met with EPIC and started to identify and work toward some type of performance evaluation in the elementary and career guidance components.

The sample of elementary teachers was identified to evaluate the elementary objectives. There were two teachers identified in each building for a total of 84 teachers. An effort was made to identify a sample of primary and intermediate teachers. The teachers responded to the evaluation of their career education activities by using the summary rating forms.

The student and teacher questionnaire for the evaluation of the Career Information Centers was reviewed by secondary teachers and finalized. It was agreed that each secondary school would identify one social studies class at each grade level to evaluate and that all teachers would be given the opportunity to respond to the questionnaire. These questionnaires would be distributed during the fourth quarter.

2. SIGNIFICANT FINDINGS OR RESULTS

The elementary teachers in the evaluation sample by in large actively participated in the evaluation and at the end of the third quarter the majority of teachers had submitted the evaluation rating forms.

The CIC Questionnaire was administered to the selected sample of junior high students and all junior high instructors during the fourth quarter of this past project year.

3. PROBLEMS

Due to the delay in identifying a third party evaluator, more performance objectives were not evaluated this past year, however, plans are to do more performance evaluation in 1975-76.

4. DISSEMINATION ACTIVITIES

The evaluation forms and questionnaires for both the elementary and the CIC were reviewed by instructors, modified, duplicated, and administered this project year.

5. DATA COLLECTION

Data was collected on the performance objectives at the elementary level and the CIC. This data was turned over to EPIC who is in the process of compiling our second evaluation report.

6. PROGRESS ON EVALUATION PLANS AND PROCEDURES

See sections 1 through 5 of this component.

7. OTHER ACTIVITIES

During the project year discussion and plans were made for developing and administering some type of performance evaluation in some of the other components.

8. STAFF UTILIZATION

The EPIC representative and project staff are the major staff members in this component.

9. FUTURE ACTIVITIES PLANNED FOR NEXT REPORTING PERIOD

Future activities in the Evaluation component include:

1. Receiving and reviewing the Second Evaluation Report.
2. Continue to plan early in school year for performance evaluation.
3. Identify third party evaluators as early as possible.

APPENDIX

Appendix A

Elementary Newsclipping

Pop-pop-popcorn assembly

By NICK LAMBERTO / Photos by WARREN TAYLOR, TOM HOOPER

At top, is one sign the King Elementary school students made for their popcorn sale. Above, one of the "production workers" makes popcorn balls. At left, a minor crisis develops when Reinhelle Brown, 9, spills ink on a poster and Tony Davis, 10, reacts accordingly.

Some 122 children, their six teachers and two teaching interns went through a "valuable learning experience" at King Elementary School in Des Moines — and all because of popcorn balls.

Cynics may decry such activities as teaching pupils how to make popcorn balls in school classes to the neglect of the traditional three Rs. But it was much more than that.

To refute criticism, teacher Rosemary Cottington, one of the leaders, explained: "Each child became aware of the many facets involved in the making and selling any item.

"Now even when they buy a simple little candy bar each child will know a lot went into the making of that candy bar — raw materials, manufacturing, advertising, selling."

Said Elise A. Huntsman, another teacher: "A lot of different products were discussed — puppets, books, T-shirts, cookies, candy, apples, but the children decided on the product."

The popcorn ball manufacturers were members of Unit B at King school. Unit B is made up of children 8 through 10 who would be called third and fourth-graders in some schools. They sold "the product" mainly to others among the 470 pupils at the school.

Teacher Frankie Violette said the children "realized the importance of co-operative working — some worked on the assembly line, some sang commercials over the school intercom, some painted signs."

Teacher Angelyn King said the children set up an assembly line at school with three electric poppers, a crew of melters mixing marshmallows and margarine on hot plates, a crew of makers who molded the popcorn into balls, and wrappers, counters and sellers in booths.

The children made about 250 popcorn balls in 45 minutes and after five selling days of about two hours each day sold 1,252 popcorn balls. Most of the balls sold at 10 cents each, but if a youngster was short a few pennies the balls sometimes went for less.

Early in the project the children had formed a company with Stephanie Williams as president and Jeff Cutler as comptroller and had negotiated a loan of $30 from the First Federal State Bank.

Other teachers involved included Pamela Hugunson and Rebecca Anderson. The children figured out that each popcorn ball would cost them 7 cents so they decided on a 3-cent markup.

They shopped for raw materials and organized committees. Some children found out they didn't like assembly line work. They all found out the rudiments of making a product and selling it.

At the end, the group had expenses of $94.72 and receipts of $125.22, leaving a profit of $30.50.

"But they know there was no labor or overhead costs," said Mrs. Cottington. "They plan to buy something for the school with the profits.

"Every child studied extensively before the decision was made on the product. They learned a lot and so did we.

"They now realize that in this country there are unlimited choices, a whole world of opportunity. They can all raise their sights."

Appendix B

Elementary Newsclipping

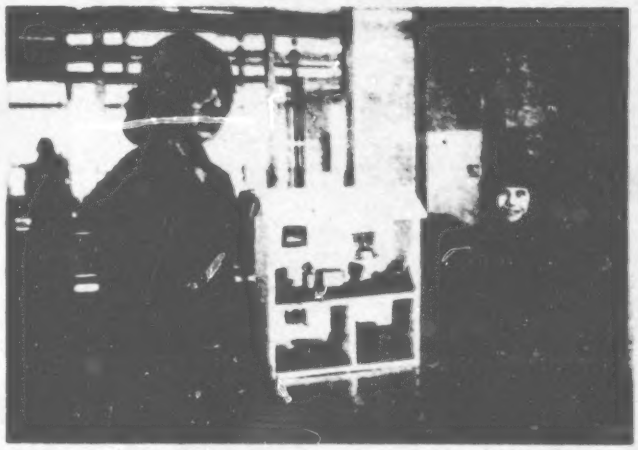
Chalk Talk

Chalk Talk is published five times per year by the Office of School-Community Relations, Des Moines Independent Community School District, 1800 Grand Avenue, Des Moines, Iowa 50307. It is distributed to all school employees, PTA Presidents, School Board Members, Community Leaders, and Members of the News Media.

March/April, 1975 Volume 7 Number 4

Des Moines Independent Community School District
Bob Baldwin, Editor H.R. Hindal, Copy Editor

MANN CLASSES BUILD HOUSES



About 90 fifth and sixth graders at Mann elementary school built and furnished doll houses during their study of the World of Construction in career education last fall. Early this year they presented the houses to the Mann kindergarten classes. After the presentation, Danny Henderson (left) and Kenny Reed (right) posed with Tina Quick and one of the houses.

POLICE HELICOPTER VISITS WASHINGTON

Students at Washington elementary school crowd around the Des Moines Police Department helicopter on a blustery early spring day. Sergeant David Noel, pilot, explains how and when the helicopter is used. The craft visited a number of Des Moines elementary schools last fall, winter and this spring.

Chalk Talk
May - June 1975

Appendix C

Elementary Newsclipping

Junior Boat Builders

KINDERGARTNERS SAIL THROUGH PROJECT

By Lillian McLaughlin

The students "were participating in an activity developing an awareness of many careers in the marine science cluster."

Hacking through the academic foliage, one discovers that this means big kids were helping little kids make toy sailboats.

It was dear to watch.

The big kids were eighth- and ninth-graders at McCombs Junior High School, 201 County Line Road. The little kids were the afternoon kindergartners from Mann Elementary School, S.W. Eleventh and Amos Streets.

The kindergartners, captained by their teacher, Berniece Hoschar, flanked by a crew of three mothers, arrived in a school bus. They stopped by Principal Wendell Miskimmins office to greet him with a cheer to lift the ceiling ("Yeaaaaa . . . McCOMBS!").

Mrs. Hoschar and the mothers wore Berniece-designed dresses, denim blue, long skirts, with overall-like top ("our working world dresses"). Kids wore their Horace Mann T-shirts (those who had remembered to do so).

The sailboat construction was part of a cluster (a subject unit) that's part of a series of clusters that's part of a three-year program in career education.

Last year's future careerists looked into communication, marketing and other fields. Next year's will investigate such fields as manufacturing, fine arts and humanities, public service. . . .

Now, if this seems a bit ponderous for kindergartners, it's only a cover for some pretty interesting goings-on: The subject marine science can lead to Gray's Lake, The Pier, the Des Moines Water Works, even a fish market!

In the big industrial arts room, kindergartners met

Boats—
Please turn to Page Three

Tina Quick, 5, in top photo squeezes paste into hole for mast of sailboat Jeff Lehman, 14, of 7902 S. W. Tenth Place is helping her make in McCombs Junior High School industrial arts room. Tina spoke no English when she arrived in the United States last July to become part of the family of Mr. and Mrs. Dick Quick, 1017 Geil Ave. She is "making it through kindergarten" fine, her mother says. Below, Tina stands by with sandpaper as Jeff nails mast in place. Now for the sail!

Youngsters Build Toy Sailboats

Boats--

Continued from Page One

their "teachers," members of a World of Manufacturing class. ("We build stuff, like a hangar, a rocket, CO-2 cartridges, screw drivers, tool boxes,'' translated Kent O'Connell, 14, of 1210 Johnston St.)

The builders fell to work, skipping academic lingo. In no time at all jig-saws were roaring along accompanied at times with a noisy recording of "Hanging Out."

They'd learned about "another boat" earlier this year, Mrs. Hoschar reminded them. What was its name? Puzzlement.

"The kind of boat somebody came over on . . ." she hinted.

"Pilgrims!"

Well, close enough. Back to more interesting things, kindergartners wielding the sandpaper, brushing on the lacquer, squeezing glue into a tiny hole to hold the mast, finally hanging on bright, variously covered sails (which appeared to have come from the Hoschar scrapbag).

These kindergartners may not grow up to be shipbuilders, but there are some potentially expert pasters, sandpapers and painters in the group.

In an hour there were some 30 sailboats. Left at McComb to dry, they'll be shipped over to Mann in time for fulfillment of a Home Work assignment sheet given each kindergartner at the end of the hour. ("Let's tell or report what we think about when we see our sailboats.")

4-23-75

Appendix D

Elementary Newsclipping

TRIBUNE PHOTO BY CHUCK ANDERSON

THE ART OF RUGMAKING

Cathy Harper, 12, weaves fabric into a rug under the watchful eye of her tutor, Henry Nosback of 4201 Beaver Crest Drive, at an art fair at Rice Elementary School. Nosback, whose 100th birthday anniversary was Tuesday, has been hooking rugs as a hobby since he retired 10 years ago as a shoe repairman in Ames. He lives with his daughter, Mrs. Carylyle Peterson, near Cathy's parents, Mr. and Mrs. James Harper of 4205 Beaver Crest Drive.

Appendix E

Elementary Newsclipping

Scope

Published by Blue Cross and Blue Shield of Iowa
636 Grand Avenue - Des Moines, Iowa 50307

Vol. 5 - No. 22 Wednesday, May 28, 1975

STUDENTS PLAY "GAME OF HEALTH"

Students at Logan Elementary School played a new game Thursday afternoon. They played "The Game of Health" by assuming roles of workers, physicians, nurses, pilots, TV stars, and Blue Cross and Blue Shield employees.

The game was created by Blue Cross and Blue Shield of Iowa as a pilot educational experiment through the Greater Des Moines Chamber of Commerce Business - Education Alliance. The patented game involves role playing, instant health care and recovery, decision making, chance, and health care expenditures.

The purpose of the game is to familiarize students with health care decisions and to encourage the consideration of health careers.

Appendix F

Junior High News Article

Callanan Students 'Go to Work'

4-13-75
TRIBUNE

About 140 seventh-grade students at Callanan Junior High School took a day off from classes Tuesday, but that didn't stop them from learning.

Lisa Olson, 12, learned how doctors take out stitches.

Darren Giese, 13, learned what it's like to produce a newsletter that's sent all over the state.

And Terry Janssen, 13, learned "You get dirty a lot" when you repair a garden tractor.

Instead of attending classes, the students went to work with their parents, relatives or friends to get some on-site insight into the working world.

It's part of a career education program financed by a $1,500 grant from the State Department of Public Instruction said Morry Hanson, a guidance counselor at Callanan.

"So many kids complain about working in school," he said. "I hope this gives them a realistic notion about working."

Besides going to work, the students are expected to interview their parents and co-workers about their jobs, Hanson said. The students then will report to their classmates on their experiences and what the various jobs are like, he said.

Hanson said the sites of the students "on-job" experiences included factories, hospitals, offices and repair shops.

He said a few students weren't able to accompany their parents because of the nature of the work, like the Drake art professor who was teaching about the painting of live nudes.

For some of the students, like Wynn Merryman, 13, her day started about an hour and a half earlier than usual because her father, Wayne Merryman, opened the service department at Holiday Chrysler, 4730 Merle Hay Road at 7 a.m.

Wynn said she like watching her father work better than attending school. She expressed some amazement that so many different things — repair work, car selling and office work — were going on at the car dealer's.

On the other hand, Terry Janssen, 13, said he had worked at his father's shop before, and he figured he could attach a blade to a motor of a garden tractor. His father owns Krumm Sales and Service, 825 E. University Ave.

Meanwhile, Darren Giese, 13, was watching his father work as the executive director of the Iowa Career Education Advisory Council in the Statehouse office complex.

Darren decided that working 40 hours a week might take a lot more effort than going to school. Besides, he said of his father's job: "It's more complicated than I thought."

— Melinda Voss

Appendix G

Junior High News Article

STUDENTS HELP ELDERLY IN HANDYMAN PROGRAM

Eleven junior and senior high school boys and a girl are providing handyman and chore service to the elderly in Des Moines under a new program started last September.

The Handyman/Chore Services program is headquartered at Hiatt junior high school and uses students from Callanan, Hiatt and Irving junior high schools and East and Tech senior high schools.

Students in the program work 12 hours each week at the rate of 3 hours per day for 4 days and are paid $2.00 per hour. They attend school classes four half days and one full day per week.

The students, under the direction of two supervisors, have performed 85 minor home repairs for 69 persons, spending a total of 777 hours on the projects in the seven months through March.

Working under the supervision of the directors of the Model Cities Senior Citizen Office, the Gateway Opportunity Center, the Capitol View Opportunity Center and the Logan Opportunity Center, the students have been assigned to 21 projects classified as chore services requiring 441 hours.

The boys also completed 1,184 yard work and snow removal projects for 147 persons, requiring 752 hours of work.

Students participating in the project may repair broken windows or replace window panes, repair broken stairs and stair railings, do minor water pipe and faucet repair, unclog sinks and stools, repair or replace broken doors, install and repair ramps, safety bars and other safety equipment, install or repair weather stripping on doors and windows, clean and repair light fixtures, repair drawers, shelves and cabinets and do minor furnace and heating stove repair.

Three students cut a length of gutter for a house as part of their Handyman chores. The three were replacing all the gutters and downspouts on the house, under the watchful eye of Virgil Douglas (second from right), work supervisor. Students pictured are (from left) Linda Jo Rhiner, East high school sophomore and the newest recruit in the project; Bill Botts, another East sophomore; and Kevin Burkett, ninth grader at Hiatt junior high school.

The boys also will do minor repairs on sidewalks, house siding, wall and ceiling plaster, stop basement leaks, repair broken or loose flooring and thaw frozen water pipes.

All repair and installation work is of a minor nature and must not require the use of special tools. Limitations are placed on some projects, such as no more than 10 per cent of house siding repair or replacement and no more than three hours work on a basement leak.

Examples of chore services provided include installing, cleaning and repairing storm doors, storm windows and screens, installing and removing curtains and window shades, cleaning shelves and cabinets, some housecleaning tasks, cleaning basements, snow removal, lawn mowing, hedge trimming, picking up fallen branches, delivering packages and assisting in shopping.

Persons over 60 years of age are eligible for the service, but priority is given to low income, minority and handicapped persons. Most of the work during the first seven months of the program has been provided in the six prime service areas which include Model Cities - Central Place, Woodland-Wilkie, Pioneer-Columbus, Logan, Southeast and Four Mile.

The project, supervised by Marsh Houston, Handyman/Chore Service appraiser, was funded by the Central Iowa Regional Association of Local Governments, Office of Community Development and the Des Moines Public Schools.

Houston said the objectives of the program are to meet the needs of the elderly for emergency repair service, to teach the elderly how to perform routine repair jobs, to provide services which will make a house more liveable and thus encourage the elderly to remain in their own homes, to eliminate hazardous conditions in homes of the elderly and to advise the elderly on preventive maintenance methods.

Chalk Talk

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May/June, 1975 Volume 7 Number 5

Des Moines Independent Community School District

Bob Baldwin, Editor H.B. Hindal, Copy Editor

Appendix H

Career Interest Survey

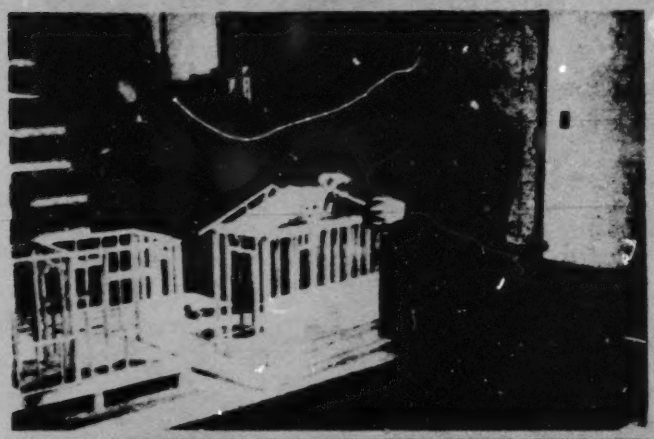
Appendix I

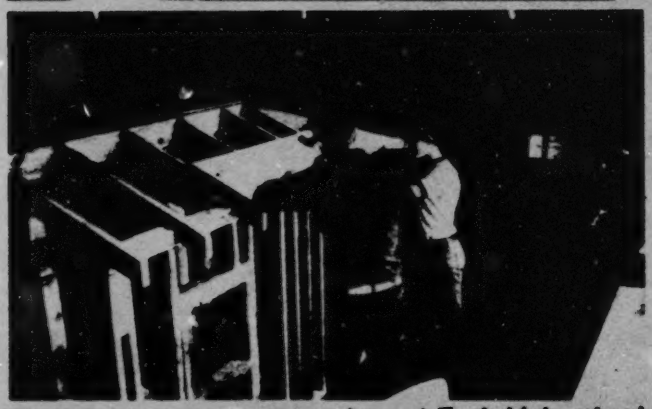
Employment Survey

See Appendix J

Senior High News Article

SOPHOMORES WORK ON SCALE MODELS





The sophomore carpentry class at Tech high school works on scale models of two sizes before venturing to work on a full-size house. In top photo, John Huxford works on the roof of his small scale model. In bottom photo, Don Hartman (with back to camera) and Pat Stahowick start work on the roof of the half-scale model in Paul Hindal's class.

CHALK TALK
May - June 1975

Appendix E

Senior High News Article

PAGE 52 WAS REMOVED FROM

THIS DOCUMENT PRIOR TO ITS BEING SUBMITTED TO

THE ERIC DOCUMENT REPRODUCTION SERVICE.

Appendix L

Tech High News Article

D.M. poster winner receives $500 prize

U.S. Representative Neal Smith (Dem., Ia.) presents a $500 check Thursday to Ernest Terrell, 17, a Des Moines Technical High School student, who won the grand prize in a national maritime poster contest. The presentation was made in Washington, D.C., during a Maritime Day luncheon. The winning poster, held by Terrell, will be displayed in post offices and on American ships this month. Terrell is a son of Mr. and Mrs. Clifford Terrell of 1066 Sixteenth St.

6-75 TRIBUNE

Appendix M

Brochure

Accounting

CHECK TECH

ACCOUNTING

57

DES MOINES TECHNICAL HIGH SCHOOL

1200 Grand Avenue, — Des Moines, Iowa 50307
High School 284-7846 — Counselor's 284-7882

Appendix N

Brochure

Auto Body

CHECK TECH

AUTO BODY

61

DES MOINES TECHNICAL HIGH SCHOOL

1800 Grand Avenue, — Des Moines, Iowa 50307
High School 284-7846 — Counselor's 284-7882

Appendix O

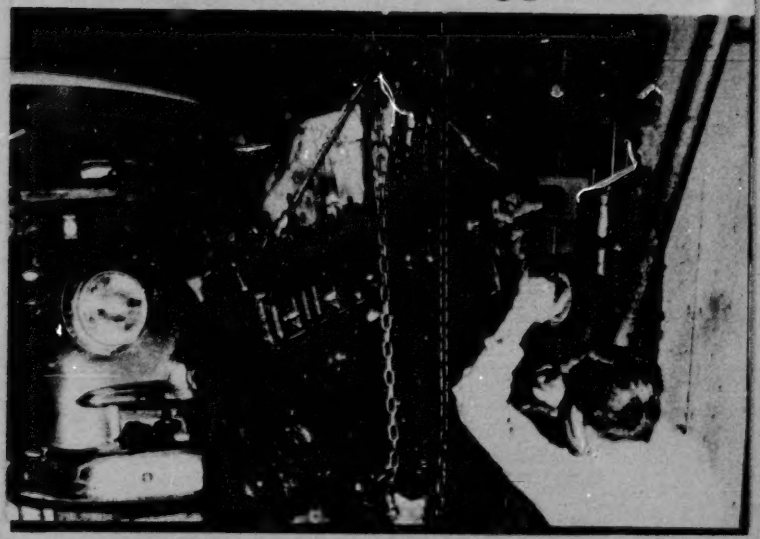
Brochure

Automotive

CHECK TECH

AUTOMOTIVE

65



DES MOINES TECHNICAL HIGH SCHOOL

1800 Grand Avenue, — Des Moines, Iowa 50307
High School 284-7846 — Counselor's 284-7882

60

Appendix P

Brochure

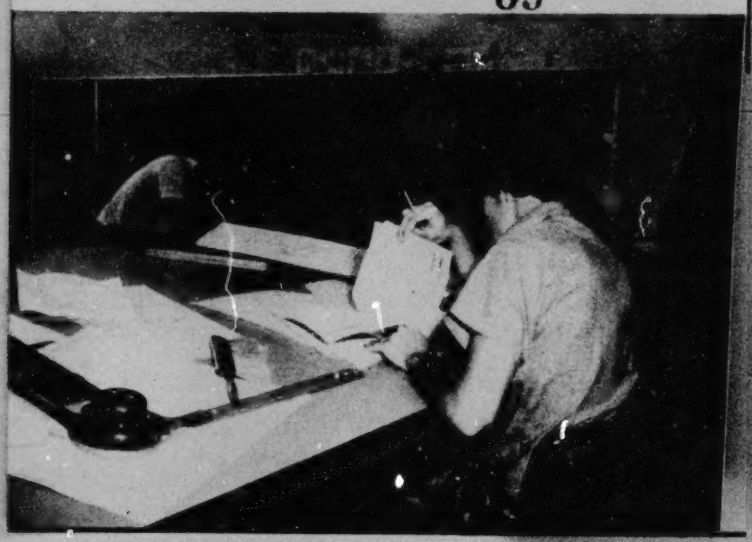
Arch. Drafting

CHECK TECH

ARCH.

DRAFTING

69



DES MOINES TECHNICAL HIGH SCHOOL

1800 Grand Avenue, — Des Moines, Iowa 50307
High School 284-7846 — Counselor's 284-7882

Appendix Q

Brochure

Machine Drafting

CHECK TECH

MACHINE DRAFTING

DES MOINES TECHNICAL HIGH SCHOOL

1800 Grand Avenue, — Des Moines, Iowa 50307
High School 284-7846 — Counselor's 284-7882

Appendix R

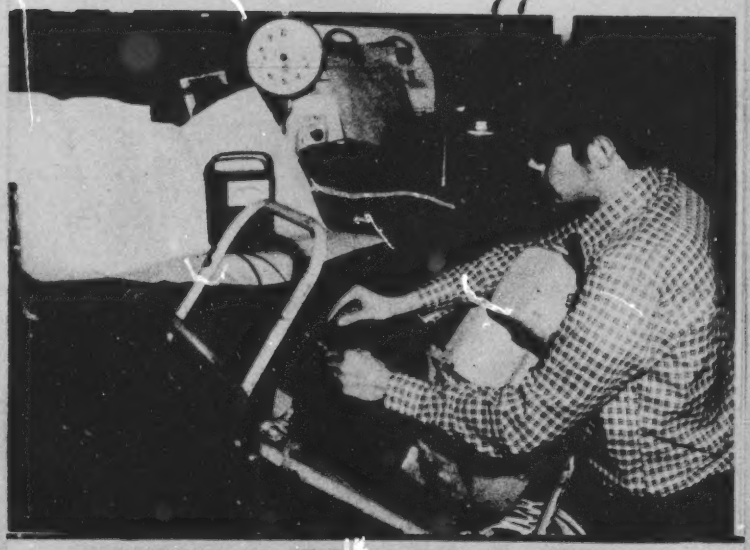
Brochure

Industrial Electricity

CHECK TECH

INDUSTRIAL ELECTRICITY

77



DES MOINES TECHNICAL HIGH SCHOOL

1800 Grand Avenue, — Des Moines, Iowa 50307
High School 284-7846 — Counselor's 284-7882

65A

Appendix S

Brochure

Radio Television

CHECK TECH

Radio
Television

81

DES MOINES TECHNICAL HIGH SCHOOL

1800 Grand Avenue, — Des Moines, Iowa 50307
High School 284-7846 — Counselor's 284-7882

Appendix T

Career Placement Center News Article

MEDIA HONORED FOR HIRE YOUTH HELP

A television station, radio station and a billboard company have been recognized for promoting the employment of youth in Des Moines.

Plaques were presented by Dr. Dwight Davis, superintendent of Des Moines Public Schools, at a luncheon hosted by Robert Ball, director of the schools' Career Placement Center.

Receiving recognition were KCCI-TV, Des Moines, Radio Station KSO, Des Moines, and Naegele Outdoor Advertising Company, Des Moines.

CHALK TALK APRIL 1975

ACCESSION NUMBER: VT102524

PUBLICATION DATE: JUN75

TITLE: PERFORMANCE SKILLS PROFILE. EXEMPLARY PROJECT. FINAL REPORT.

DESCRIPTOR: DEVELOPMENTAL PROGRAMS; *VOCATIONAL EDUCATION; *PERFORMANCE CRITERIA; *PROFILE EVALUATION; STUDENT EVALUATION; *SKILL ANALYSIS; *CHARTS

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 74P.

ABSTRACT: THE VOCATIONAL GUIDANCE COUNSELOR AT CONTOOCOOK VALLEY REGIONAL HIGH SCHOOL IN PETERBOROUGH, NEW HAMPSHIRE DEVELOPED INDIVIDUAL PROGRESS CHARTS OF PERFORMANCE SKILLS PROFILES FOR EACH VOCATIONAL COURSE OFFERED. THE PURPOSE OF THE SKILLS PROFILE IS TO REPORT A STUDENT'S PROGRESS IN TERMS OF THE SKILLS LEVEL ATTAINED, AND THUS PROVIDE SPECIFIC INFORMATION TO STUDENTS, PARENTS, TEACHERS, PROSPECTIVE EMPLOYERS, OR ADMISSION COUNSELORS. INCLUDED IN THE REPORT ARE THE PROFILES THAT WERE DEVELOPED FOR THE FOLLOWING AREAS: BUILDING CONSTRUCTION, VOCATIONAL DRAFTING, ELECTRONICS, RESIDENTIAL WIRING, HEALTH OCCUPATIONS, FOOD SERVICES, OFFICE PROCEDURES, ACCOUNTING, MACHINE TOOL PROCESSES, GRAPHIC ARTS, AND HORTICULTURE. (NJ)

INSTITUTION NAME: CONTOOCOOK VALLEY REGIONAL SCHOOL DISTRICT, PETERBOROUGH, N.H.

SPONSORING AGENCY NAME: NEW HAMPSHIRE STATE DEPT. OF EDUCATION, CONCORD. VOCATIONAL-TECHNICAL EDUCATION DIV.

102524

CONTOOCOOK

VALLEY

REGIONAL H. S.

PETERBOROUGH, NEW HAMPSHIRE

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AREA
VOCATIONAL
CENTER
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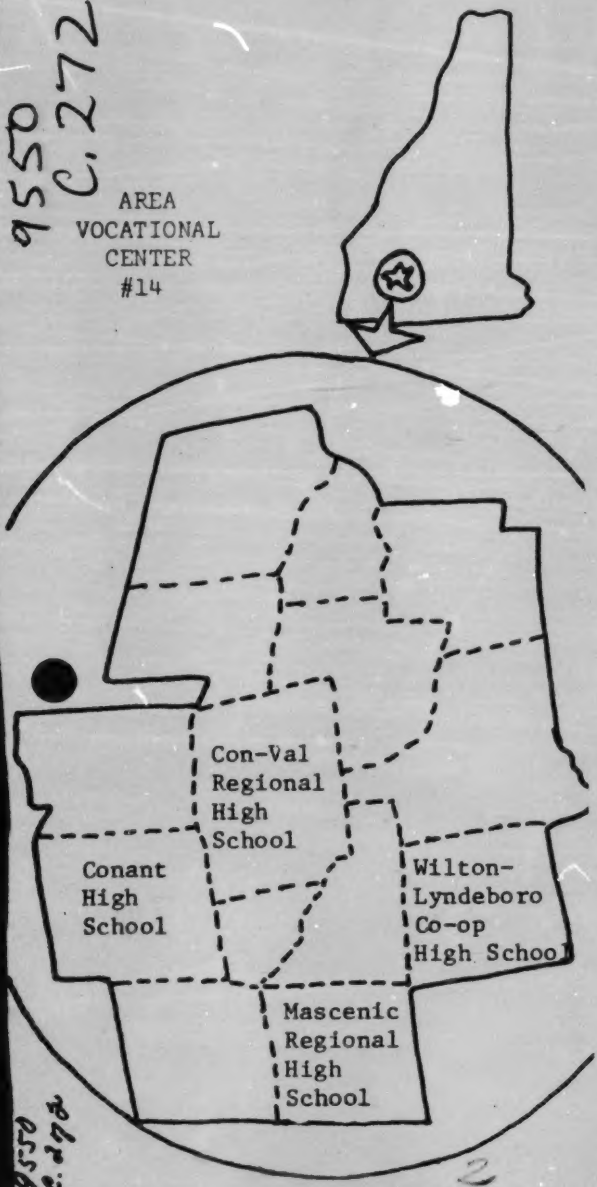

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CAREER DEVELOPMENT FOR ALL

Career development education--that aspect of an individual's life-long growth relating to his vocational possibilities, directions, accomplishments, and economic independence--is needed by everyone.

Vocational education is constantly being expanded and updated to include career training in new occupational fields--and is also being made more flexible year by year under the State's Area Vocational Plan.

Contoocook Valley Regional has been designated as one of the 20 Area Vocational Centers in New Hampshire.

Under this Area Vocational Plan, students from "satellite" schools can attend an approved Area Vocational Center on a half-day basis to pursue the vocational training of their choice. Conant High School (Jaffrey), Mascenic Regional (New Ipswich), and Wilton-Lyndeboro (Wilton) are "satellite" schools in Area 14. Tuition and travel allowances are paid by the State of New Hampshire.

This is the concept of "the comprehensive student in the comprehensive high school."

AREA
VOCATIONAL
CENTER

Program Offerings	Con-Val Regional	Conant High	Mascenic Regional	Wilton-Lyndeboro Co-op
AGRICULTURE				
Horticulture		■		
DISTRIBUTION				
Distributive Education		■		
Diversified Occupations	■	■		■
HEALTH				
Health Occupations	■			
HOME ECONOMICS				
Consumer & Homemaking	■	■	■	■
Food Service	■			
OFFICE				
Clerical	■	■	■	■
Secretarial	■	■	■	■
Accounting	■	■		
TRADES & INDUSTRY				
Building Construction	■		■	
Drafting	■			
Electronics	■			
Graphic Arts		■		
Machine Tool	■			
Residential Wiring	■			

HORTICULTURE

The horticulture program is a combination of classroom and field work dealing with such areas as landscape, ornamental design, floriculture, greenhouse production and preparation for employment in the field.

Classroom work will include:

Plant classification
Plant physiology
Genetics
Soils
Entomology
Control of pests

Field work will include:

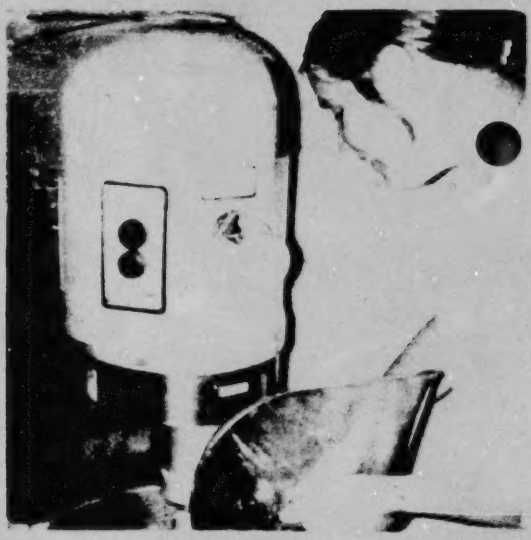
Layout, design and practical application
Growing flowers
Actual forest management
Greenhouse work
Keeping records
Buying and selling

DISTRIBUTIVE EDUCATION

This program is designed to provide a student with the facts of economic life together with the methods employed in the conduct of business enterprises.

Areas covered include: Business law and its connection with individual living, marketing, advertising in various media, distribution of merchandise from manufacturer to consumer, display and merchandising, warehousing, and direct sales--mail order, retailing wholesaling, and franchising.

Students will operate a school store, "Pier 47", in addition to co-op assignments in the local community.



DIVERSIFIED OCCUPATIONS

Through diversified occupations, students are placed in training situations in the community--auto mechanics, retailing, agriculture, or other areas not presented in the regular school curriculum.

Training profiles are established by the school and approved by the employer.

Released time from school may be arranged to allow the student to work a minimum of 15 hours a week for a full school year.

CONSUMER AND HOMEMAKING

The important thing to remember is that home economics courses, under the Secondary School Program of Vocational Education, offer a much wider choice of subjects than ever before--subjects that can help you become a well-rounded person, a capable home manager, and even a skilled worker in the hotel/motel field.

The emphasis is still on homemaking but not just cooking and sewing. Much more attention is paid to the homemaker's role as a consumer satisfying individual needs and those of the family

HEALTH OCCUPATIONS

An overall introduction to the health field and its many options comprise the first part of this program.

The students will learn job entry skills on the assistant or aide level in the areas of nursing care, dietary, laboratory, and x-ray. Emphasis is placed on anatomy and physiology in relation to disease and health care.

An integral part of the health occupations program is the on-the-job training at Monadnock Community Hospital.

The second year is concerned with community health occupations (public health, social work, day care centers, doctors' and dentists' offices). There is an affiliation with Crotched Mtn. Rehabilitation Center.

Students choose a specific occupation and pursue it by way of independent study and on-the-job training.

FOOD SERVICE

Students enrolled in the food service program study a comprehensive food course which includes preparation cooking, baking, and serving of foods for restaurants, hotels, school cafeteria, etc.

Types of service, inventory, sanitation, portion control, knowledge of equipment, storage are integral parts of the course.

Co-op arrangements with restaurant in the area are established when the students are adequately prepared.

CLERICAL OFFICE PROCEDURES

Clerical Office Procedures develops and upgrades skills necessary for employment in an office setting.

The acquiring of proper attitudes and behavior appropriate in an office and practice on all types of business machines is stressed.

Students will gain a working knowledge of adding machines, calculators, electronic calculators, duplicator, mimeograph, and offset duplicator.

It further develops skills on both electric and manual typewriters. Units in office communications systems, filing, composition of business letters, and data processing are included.

In-school and co-op work experience is provided.

SECRETARIAL OFFICE PROCEDURES

The basic objective of this course is to provide the added preparation needed by office occupation majors to enable them to qualify for beginning office employment.

The course will include office dictation and transcription (stenography), typing business papers, the use of office communications systems, composing business letters, filing, and data processing. The course also includes practice on the business machines commonly found in offices.

In-school and co-op work experience is provided.

ACCOUNTING

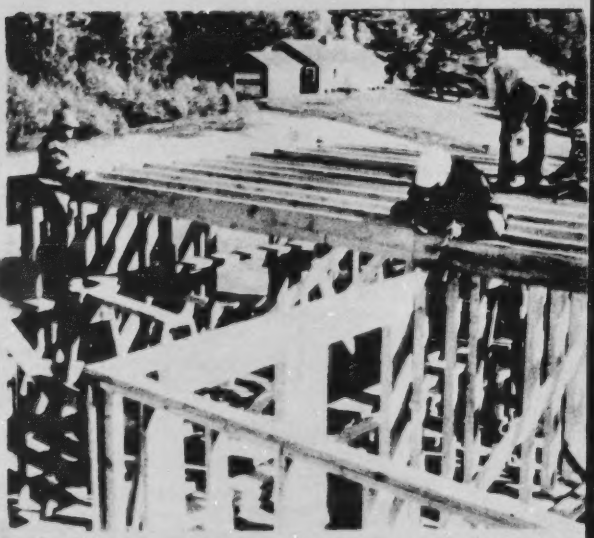
The basic theory and practice of the accounting cycle is studied in this course. This includes recording of transactions in the journals, posting to the ledgers, the trial balance, working papers, financial statements, and the opening and closing of books.

Various problems and practice sets give the students experience in keeping financial records for different types of businesses.

BUILDING CONSTRUCTION

Learning by doing is stressed in this program as students plan and build a complete house in the community.

The course develops skills needed in occupations within the building trades. Students perform in subcontracting areas such as site development, plumbing, masonry, dry wall construction, and painting. In addition, architectural plan reading and sketching, rough and finish carpentry techniques are covered.



During the second year, the building construction "crew" is responsible for building a complete structure, applying previously learned skills.

DRAFTING

The draftsman's print is the controlling document of the manufacturing process. It provides the detailed specifications of the product which the engineers and designers have created--specifications which then guide every step of manufacture from purchase of materials to final inspection.

Emphasis is placed on a variety of drafting types, proper use of tools, projection techniques, dimensioning practices, and shape descriptions.

During the second year of the program, students pursue an individualized program stressing electrical, machine tool, or architectural drafting.

Co-op arrangements are made to further one's training.

ELECTRONICS

This technical offering covers constructing, assembling, testing, and repairing of electronic equipment and circuits.

Demonstration, discussion, research, and lab activities assure an individual program for each student.

Areas covered during the first year include: Electron theory, AC & DC theory, Vacuum tubes, Semi-conductor devices, and meters & measuring devices.

The second year emphasizes communications and industrial electronics. Topics studied include the principles of TV, radio, antennas, control circuits, timing circuits, and any area of special interest to the student.

Co-op arrangements are encouraged.

GRAPHIC ARTS

The program is designed to provide a working knowledge of the developing of an idea into a graphic design either in letter press, offset lithography or photographic silk screen.

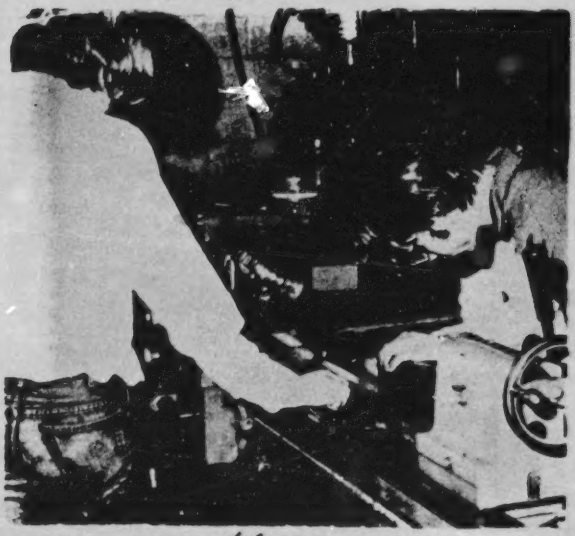
The course will cover: Introduction to paper, layout and design, introduction to copy camera work together with darkroom technique, study of various films for line work and halftone reproduction, stripping techniques for one- and two-color work, platemaking, bindery work, and the operator of the offset press study of problems encountered.

MACHINE TOOL AND METALS

For the student interested in practical, on-the-job training in local machine and metal industries. Classroom and shop instruction are given at the school. When the student has acquired good basic knowledge and skills, he/she will be placed on a job at NHBB or other companies in the community.

Areas of study and work include:

Measurement
Layout
Bench work
Drill presses
Lathes
Millers
Grinders
Tooling
Sawing
Testing
Heat Treating
Metallurgy
Bearings
Other processes



RESIDENTIAL WIRING

The residential wiring program is aimed at providing job entry skills in the electrician field.

Through lab work and on-the-job experience at the building site, students learn the complete wiring process.

This includes:

Installation of service entrance
Roughing in
Planning circuits
Installation of fixtures
Installation of appliances
Finishing in
National Electric Code

FOR FURTHER INFORMATION:

Contact a member of the Area Vocational Center #14 Advisory Committee:

Steve Buckley	Jaffrey-Rindge
Ivan LaPalme	Jaffrey-Rindge
Alvah Niemela	Jaffrey-Rindge
Dennis Boudreau	Jaffrey-Rindge
Robert Eaves	Mascenic
Russell Cook	Mascenic
Charles Hamel	Wilton-Lyndeboro
Robert Henning	Wilton-Lyndeboro
Hubert Hoover	Wilton-Lyndeboro
Lois Harriman	Con-Val
Mark Wheeler	Con-Val
Edwin Farhm	Con-Val
Edward Hamblin	Con-Val
Lloyd Eves	Con-Val
Robert Morrill	Con-Val

or

the Guidance Counselors at:

Conant High	532-7744
Con-Val High	924-6363
Mascenic Regional	878-1113
Wilton-Lyndeboro	654-7551

Produced By

Contoocook Valley Regional High School
Vocational Department
Peterborough, New Hampshire

"Learning a Living"

V O C A T I O N A L

E D U C A T I O N

OTHER SERVICES INCLUDE:

- Career Information Center
- Vocational Counseling
- Job Placement
- Educational Placement
- Aptitude & Interest Testing
- Student Profiles
  for career planning
  for prospective employers
- Individualized Programs To Meet Special Needs

FINAL REPORT - EXEMPLARY PROJECT

PROPOSALS SUBMITTED TO THE DIVISION OF VOCATIONAL-TECHNICAL EDUCATION

UNDER THE AUTHORITY OF

THE VOCATIONAL EDUCATION AMENDMENTS OF 1968, P.L. 90-576

EXEMPLARY PROGRAM OR PROJECT OPERATIONAL GRANT

TITLE OF PROPOSAL: Performance Skills Profile

APPLICANT ORGANIZATION: Contoocook Valley Regional High School
Route 202 North
Peterborough, New Hampshire 03458

INITIATED BY: Edwin O. Farnum
Edwin O. Farnum
Vocational Guidance Counselor
Telephone - 603-924-6363

PROGRAM/PROJECT DIRECTOR Edward W. Hamblin
Ed Hamblin
Vocational Director
Telephone - 603-924-6363

TRANSMITTED BY: Edward W. Hamblin
Ed Hamblin
Vocational Director
Telephone - 603-924-6363

DURATION OF ACTIVITY: July 1, 1974 - June 3, 1975

TOTAL FUNDS REQUESTED: $ 1899. for the first year

$ _____ for duration of program

DATE TRANSMITTED: May 29, 1974

VT 102 524

ABSTRACT

Title of Proposal: Performance Skills Profiles

Program Director: Edwin O. Farhm

Applicant Organization: Contoocook Valley Regional High School

Beginning Date: July, 1974 Ending Date: June 31, 1975

In keeping with the behavioral objectives format which has been implemented in the vocational program at Contoocook Valley Regional High School, the vocational guidance counselor had developed a skills profile system. The purpose of the profiles developed is to hi-lite a student's ability in the specific program he pursued while at Contoocook Valley, the information to be shared with student, parents and prospective employers or admissions counselors.

Profiles were developed by the vocational guidance counselor working with vocational teachers from the following areas:

1. Building Construction
2. Vocational Drafting
3. Electronics
4. Residential Wiring
5. Health Occupations
6. Food Service
7. Secretarial Office Procedures
8. Clerical Office Procedures
9. Accounting
10. Machine Tool Processes
11. Graphic Arts
12. Horticulture

The data collection system has also been developed using performance charts which are kept for the vocational programs.

In addition, a descriptive flyer covering all vocational education programs at Contoocook Valley Regional has been designed.

STUDENT PERFORMANCE SKILLS PROFILES

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Method of Investigation

Recommendations

INTRODUCTION

Rationale or Need -- From its very beginning, the vocational educational program at Contoocook Valley has followed a behavioral objectives format. Course descriptions were clearly written and continue to be revised. These outlines specify the expectations placed upon the student and what skills or outcomes, will be developed as a result of the student's participation in the vocational program.

Although the content of the offerings has been well defined, the grading system continued to be traditional, that is continued to measure a student's achievement in terms of letter grades A, B, C, etc.

From the first year of the program, it has been deemed essential that a more concise and efficient method of reporting a student's progress and skills level be developed.

Also, the school has seen the role of job placement as a high priority of its guidance department.

In reviewing reporting systems used at most schools in New Hampshire, it was found that this type of system would be unique for New Hampshire and thus this project would benefit vocational education throughout the state.

Specifically this project benefits vocational education in the following ways: 1) Reporting system to supplement the present grading system used at most New Hampshire schools.

2) Profiles assist school personnel in job placement.

3) Profiles provide a course description which assist school personnel and students in course selection.

4) Profiles will serve as models for other schools to follow.

Statement of the Problem -- Initially, a progress chart was developed which allowed teachers to "report" a student's progress on selected tasks. However, this was soon discarded by most teachers as the record keeping and reporting of this information was too cumbersome. Since one chart was developed to cover all vocational areas, teachers were required to write in the specific tasks or objectives covered. Guidance had the awesome task of collecting this data each quarter of the year, on each vocational student, in each vocational program, from each progress chart.

It was soon realized that individual "progress charts" of performance skills profiles had to be designed for each vocational area and kept on each vocational student, constantly updated on a quarterly basis.

Further, in talking with members of industry it was found that publicity or a program description was in need.

Specific Objectives --

Goal 1.0 The supplement the report card grading system presently being used at Contoocook Valley Regional High School.

Objective 1.1 The vocational guidance counselor, assisted by the vocational staff, will develop criterion referenced profile sheets for each vocational program being taught at Contoocook Valley Regional High School, Area Vocational Center(# 14)

1. Building Construction
2. Vocational Drafting

3. Electronics
4. Residential Wiring
5. Health Occupations
6. Food Service
7. Secretarial Office Procedures
8. Clerical Office Procedures
9. Accounting
10. Machine Tool Processes
11. Graphic Arts (Conant High School)
12. Horticulture (Conant High School)

Activity 1.11 The vocational guidance counselor will meet with each vocational teacher individually to establish a list of selected individual tasks which will be used as part of the profile sheet describing the vocational student's proficiency level. Process evaluation - a draft of each profile ready for committee reviews will be indication that this activity has been met.

Activity 1.12 The vocational guidance counselor will develop and have printed student profile sheets for each vocational program to include the following:

- selected individual tasks representive of the program
- level of proficiency (1 - 4)
- attitude check list (work habits)

Process evaluation - completion of printed forms will be an indication that this activity has been met.

Goal 2.0 To develop a system of data collection to be used in assessing individual performance in the vocational programs at Contoocook Valley Regional High School.

Objective 2.1 The vocational guidance counselor will develop the data collection process whereby information will be recorded on studenv's performance skills profiles.

Activity 2.11 The vocational guidance counselor will prepare a list of suggested uses for the student performance skills profiles.

Goal 3.0 To publicize Contoocook Valley's vocational offerings and student outcomes as a result of vocational education at Contoocook Valley Regional High School.

Objective 3.1 The vocational guidance counselor will design and have constructed a descriptive flyer of vocational education at Contoocook Valley Regional High School.

Basic Assumptions --

1. With the increased emphasis on career education, the guidance counselors role should include job placement assistance.

2. With the increased emphasis on accountability in education, schools need to design their programs in terms of student outcomes or in behavioral objectives format.

3. A goal of career education is "that every student leaving school will possess the skills necessary to give him a start in making a

livelihood for himself and his family, even if he leaves before completing high school." This project addresses the requirement this goal places on the school to report the obtainment of a "saleable skill" by their students.

Approach --

Objective 1. -Design and development of student performance skills profiles.

1. Explanation of project to participating teachers
2. Teachers submit selected individual tasks
3. Meetings with local industry representatives
4. Final form approved by teachers
5. Offset plates
6. Printing

Objective 2. -Development of reporting student progress

1. Review of present system
2. Field test of health occupation profile
3. Writing of reporting process
4. Writing of suggested uses for student profiles

Objective 3. -Descriptive flyer

1. Write program descriptions
2. Obtain pictures
3. Write charts
4. Reviewed by vocational director
5. Camera ready copy
6. Offset plates
7. Printing

Limitations of the Project --The only restriction observed was the inability to adhere to a time schedule. Rough copy dates weren't met by teachers for the following reasons:

1. Preparation for the upcoming school evaluation evaluation required additional time.
2. Course outlines or revisions as part of the school evaluation had to come first and be approved before selected individual tasks could be identified. Also, initial project was adjusted to include descriptive flyer.

Definition of Terms --

Selected individual tasks - a measurable, piece of work representative of what's covered in unit of vocational program.

Student Performance Skills Profile - a compilation of selected individula tasks which represents or defines level of skills developed through participation in a specific vocational program.

REVIEW OF LITERATURE

Two years prior to developing the profiles, an ERIC search was conducted which did not turn up a reporting system to use as a model.

One of the first steps taken during the project, was to contact several Massachusetts schools in an attempt to find profiles already in use.

There was confusion as to "what exactly is a performance skill profile?" Greenfield (Mass.) High School sent a copy of their graphic arts check list which was helpful in determining what form our profiles should take.

METHODOLOGY

Design --Project consisted of these related, but separate, parts.

Objective 1. -Design and development of Student Performance Skills Profiles.

A. Vocational guidance counselor met with teacher in each vocational area to explain project and specific teacher requirements.
B. Vocational teacher submitted representative individual tasks (by unit) which hi-lighted two year program.
C. Vocational guidance counselor had profile reviewed by local employers or personnel managers for purpose of revision.
D. Final form approved by teacher and vocational guidance counselor.
E. Camera ready copy typed by vocational business teacher.
F. Offset plated made by business teacher.
G. Profile printed at Contoocook Valley by vocational business teacher.

Objective 11. -Development of system for reporting progress.

A. Vocational guidance counselor and vocational director met with several vocational teachers to review present reporting system and receive suggestions for improvement.
B. During third quarter, health occupations profile was used to-field test reporting system.
C. Process for reporting student progress on the Performance Skills Profile was written by vocational guidance counselor and reviewed by three vocational teacher and by the vocational director.
D. Suggested uses for the Student Performance Skills Profile was written by vocational guidance counselor and reviewed by the vocational director.

Objective 111. -Descriptive flyer

A. Concise program descriptions of all vocational offerings in area vocational center (#14) were written by the vocational guidance counselor.
B. Pictures of all vocational offerings in area vocational (#14) were obtained.
C. Chart depicting program offerings at all schools in area vocational center(#14) was designed by the vocational guidance counselor.
D. Camera ready copy typed by vocational business teacher.
E. Offset plates made by vocational business teacher.
F. Flyer printed at Contoocook Valley by vocational business teacher.

Time Schedule --Although time schedule was modified on two occasions, schedule still wasn't met by all teachers.

		ROUGH COPY DATE		CAMERA READY		NEGATIVES		PRINTED	
PROFILE	TEACHER	REQ.	ACTUAL	REQ.	ACTUAL	REQ.	ACTUAL	REQ.	ACTUAL
Health Occ.	Langille	Jan 27	Jan 27	Feb 18	Feb 18	Feb 20	Feb 20	Mar 17	Mar 17
Electronics	Eves	Jan 27	Feb 3	Feb 18	Apr 14	Apr 17	Feb 20	Apr 18	Apr 18
Res. Wir.	Eves	Jan 27	Feb 3	Feb 18	Apr 14	Apr 17	Feb 20	Apr 18	Apr 18
Acct.	Downey	Apr 11	May 19	Apr 18	June 2	Apr 21	June 6	Apr 25	June 30
Food Serv.	Roberts	Apr 11	May 5	Apr 18	May 12	Apr 21	May 15	Apr 25	May 19
Bld. Const.	Wing	May 5	June 20	May 7	June 23	May 12	June 27	May 15	June 30
Draft.	Tencati	May 5	June 20	May 9	June 23	May 12	June 27	May 15	June 30
Soc. Off.	Breton	May 26	June 20	May 28	June 23	May 30	June 27	June 4	June 30
Cler. Off.	Breton	May 26	June 20	May 28	June 23	May 30	June 27	June 4	June 30
Mach. Tool	Harkins	May 12	June 17	May 14	June 25	May 16	June 27	May 20	June 30
Grpahic Arts	LaPalme	June 20	June 20	June 23	June 25	June 25	June 27	June 30	June 30
Horticulture	Tenney	June 20	June 20	June 23	June 25	June 25	June 27	June 30	June 30

FINDINGS (END PRODUCT)

Completed Student Performance Skills Profiles

1. Building Construction
2. Vocational Drafting
3. Electronics
4. Residential Wiring
5. Health Occupations
6. Food Service
7. Secretarial Office Procedures
8. Clerical Office Procedures
9. Accounting
10. Machine Tool Processes
11. Graphic Arts
12. Horticulture

Process for reporting student progress on the Performance Skills Profiles.

Suggested uses for student Performance Skills Profiles.

Descriptive flyer - vocational offerings at Contoocook Valley Regional High School (Area Vocational Center #14).

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: BUILDING CONSTRUCTION
YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Tools

SELECTED INDIVIDUAL TASKS:

1. Measuring tools
2. Rafter & framing square
3. Handsaws
4. Boring tools
5. Bench plane
6. Circular handsaw
7. Table saw
8. Radial arm saw
9. Sabre saw
10. Electric drill
11. Power plane
12. Router-shaper-planer
13. Sanders - floor & disc
14. Sanders - belt & finish
15. Staplers
16. Nailing machines

Concrete Form Construction

1. Mixing concrete
2. Placing concrete
3. Finishing concrete slabs
4. Reinforcement for concrete
5. Estimate concrete
6. Anchor bolts
7. Forms, wall footings
8. Forms, concrete steps
9. Forms, floor
10. Forms, sidewalk slabs

Framing, Floor

1. Types of house framing
2. Sill construction
3. Deck & joist layout
4. Deck & joist construction
5. Girders, solid
6. Girders, built-up
7. Columns
8. Bridging
9. Framing floor openings
10. Subflooring

Framing, Walls

1. Wall layout
2. Wall construction
3. Framing wall openings
4. Interior partition layout
5. Interior partition construction (load)
6. Interior partition construction (non-load)
7. Sheathing
8. Scaffolds

Framing, Ceiling

1. Ceiling joist (overlay) layout
2. Ceiling joist (overlay) placement

Framing, Roof

1. Types of roof framing
2. Common rafters
3. Hip & valley rafters
4. Truss rafters
5. Dormers
6. Unequal pitch
7. Special problems

Roof Construction

1. Plywood sheathing
2. Board sheathing
3. Shingle application:
   - asphalt
   - wood
   - roll roofing

Framing, Special

1. Bays and overhangs
2. Cantilevered decks

Stairbuilding

1. Stairway layout
2. Stairway math calcul.
3. Stairway construction
4. Stairs, housed stringers
5. Stairs, open stringers
6. Newel posts & hand rails

Exterior Finish		Interior Finish		Painting	
1. Cornices	☐	1. Wall board	☐	1. Preparing wood surface	☐
2. Rakes	☐	2. Interior doors:		2. Taping joints (sheet rock)	☐
3. Soffits	☐	by pass units	☐	3. Finishing joints (sheet rock)	☐
4. Corner boards	☐	hinged units	☐	4. Interior finish:	
5. Water tables	☐	3. Window trim	☐	trim	☐
6. Belt courses	☐	4. Baseboard installation	☐	sash	☐
7. Exterior siding:		5. Closet trim	☐	ceiling	☐
clapboard	☐	6. Shelves	☐	roller application	☐
wood shingles	☐	7. Mantel	☐	interior stain	☐
vinyl or aluminum	☐	8. Cabinets:		5. Exterior finish:	
8. Window installation:		prebuilt installation	☐	trim	☐
double hung	☐	custom built	☐	clapboard	☐
casement	☐	formica installation	☐	shingles	☐
9. Door installation:		9. Flooring:		exterior stain	☐
hinged doors	☐	underlayment	☐		
sliding doors	☐	hardwood	☐		
		soft wood	☐		

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: VOCATIONAL DRAFTING
YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Iden. of Drawing Equipment

SELECTED INDIVIDUAL TASKS:

1. Drawing boards
2. T-Squares
3. Drawing paper
4. Pencils
   - types & choice of
   - sharpening
5. Triangles
6. Erasers & erasing
7. Scales
8. Drawing instruments

Use of Equip. & Instruments

1. Scales
   - Architects
   - Engineers
2. Pencils
3. Triangles
   - 45°
   - 30° - 60°
4. Compass
   - Use & sharpening
5. Alphabet of lines
6. Quality of lines
7. Secure paper to board

Lettering

1. Origin of letters
2. Single stroke gothic
3. Uniformity in lettering
4. Pencil technique
5. Guide lines
6. Lefthanders
7. Spacing of letters & wds
8. Numerals

Geometric Shapes

1. Parts of a circle
2. Triangles
3. Quadrilaterals
4. Regular polygons
5. Five regular solids
   - tetrahedron
   - hexahedron
   - octahedron
   - dodecahedron
   - icosahedron

Geometric Construction

1. Bisect horizontal & vertical lines
2. Bisect a line or arc
3. Bisect an angle
4. Draw a circle tangent to a line
5. Draw a tangent to a circle
6. Draw an arc tangent to two straight lines
7. Draw an arc tangent to straight lines & arcs

Third Angle Orthographic Proj.

1. Pictures & views
2. Revolving the object theory
3. Glass box theory
4. Hidden lines
5. Choice of views
   - two-view drawings
   - three-view drawings
6. Attitude of views
7. Preference of lines
8. Visualizing views

Techniques & Applications

1. Pencil drawings
2. Pencil technique
3. Reproduction process
4. Spacing of views
5. Points & lines in views
6. Planes & angles in views
7. Curved surfaces in views
8. Intersections and tangencies

Dimensioning

1. Complete description of objects
2. Arrowheads
3. Figures & inch marks
4. Direction of figures
5. Finish marks
6. Angles & arcs
7. Placement
8. Steps in applying
9. Size of cylinders
10. Location
11. Superfluous dimensions

Shop Processes

1. Types of shops
2. Castings
   - fillets & rounds
   - runout
   - conventional edges
3. Welding & weldments
4. Measurements (in shop)
5. The lathe & turnings
6. Finished holes
7. Machine tools
   - lathe
   - grinder - shaper
   - miller

Sectional Views

1. Full sections ☐
2. Section lining ☐
3. Visible, hidden & centerlines in section ☐
4. Half section ☐
5. Broken-out sections ☐
6. Revolved sections ☐
7. Removed sections ☐
8. Offset sections ☐
9. Ribs & spokes in section ☐
10. Conventional breaks ☐

Threads & Fasteners

1. Screw threads ☐
2. Cutting thds on lathe ☐
3. Thread forms ☐
4. Thread pitch ☐
5. Rt. & lft. hand thrds ☐
6. Multiple threads ☐
7. Symbolic & detailed thd ☐
8. Am. Nat'l screw thds ☐
9. Unified threads ☐
10. Thread notes ☐
11. USA Std. nuts & bolts ☐
12. Spec. for nuts & bolts ☐
13. USA Std. cap screws ☐
14. USA Std. machine screws ☐
15. USA Std. set screws ☐
16. Keys & keyways ☐
17. Locking devices ☐

Pictorial Drawings

1. Types
   - perspective ☐
   - isometric ☐
   - oblique ☐
2. Isometric drawings
   - sketching ☐
   - angles ☐
   - circles, arcs, ellipses ☐
3. Oblique drawings
   - angle & scale of depth axis ☐
   - choice of position ☐
4. Perspective
   - two-point ☐
   - one-point ☐

Working Drawings

1. Industrial drafting ☐
2. Checking drawings ☐
3. Standards
   - A.S.A. ☐
   - I.S.O. ☐
   - drawing ☐
4. Assembly drawings
   - outline assembly ☐
   - working drawing assembly ☐
5. Assemblies in section ☐
6. Welding drawings ☐

Auxiliary Views

1. Inclined surfaces ☐
2. Auxiliary view ☐
3. Three auxiliary views ☐
4. Reference planes ☐
5. Plotted curves ☐
6. Angles ☐
7. Auxiliary sections ☐
8. True length of line ☐

Gears & Cams

1. Types of cams ☐
2. Cam followers ☐
3. Cam motion ☐
4. Cam profiles ☐
5. Types of gears ☐
6. Shape of teeth ☐

Cooperative Work Experience

1. Architectural Drafting ☐
2. _____ ☐
3. _____ ☐
4. _____ ☐
5. _____ ☐

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: ELECTRONICS

YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Introduction to Electronics

SELECTED INDIVIDUAL TASKS:

1. Use hand tools related to electronics indus. [ ]
2. Solder [ ]
3. Identify com[illegible]ents & their sy[illegible] [ ]
4. Interpret s[illegible]ics [ ]
5. Use meters: [illegible] VOM, TRVM [ ]
6. Understand atomic theory [ ]

Meters & Meas. Devices

1. Know types of meters [ ]
2. Determine accuracy & sensitivity of meter [ ]
3. Extend voltmeters [ ]
4. Design multi-range ammeters [ ]
5. Design series ohmmeters [ ]
6. Use oscilloscope [ ]
7. Calibrate test equip. with manual [ ]

D-C Theory

1. Use ohms law [ ]
2. Understand:
   - Series circuits [ ]
   - Parallel circuits [ ]
   - Series parallel [ ]
3. Know & apply:
   - Kirchnoff's Laws [ ]
4. Design voltage dividers [ ]
5. Apply theorems:
   - Nortons [ ]
   - Thevenins [ ]
   - Superposition [ ]
6. Understand application of:
   - Thermistors [ ]
   - Varistors [ ]

A-C Theory

1. Know & compute A-C values [ ]
   - RMS [ ]
   - Peak [ ]
   - P-P [ ]
   - Avg. [ ]
   - Instantaneous [ ]
2. Select & use inductors [ ]
3. Select & use capacators [ ]
4. Understand & compute I, E, Z, X_C, X_L, power factor and phase angle for the following circuits: [ ]
   - Series RL [ ]
   - Series RC [ ]
   - Parallel RL [ ]
   - Parallel RC [ ]
   - Series RLC [ ]
   - Parallel RLC [ ]
5. Design & use the following tuned circuits:
   - Low Pass [ ]
   - High Pass [ ]
   - Band Pass [ ]
   - Band Reject [ ]

Introduction to Elec. Devices

1. Know construction & use of vacuum tubes ☐
2. Understand theory & select solid state diodes ☐
3. Cons./use load lines ☐
4. Understand & test transformers ☐
5. Construct/troubleshoot the following power supplies:
   - Xfmr full & ½ wave ☐
   - Line operated ½ wave ☐
   - Voltage doublers & triplers ☐
   - Bridge rectifiers ☐
   - Limiters ☐
6. Design, construct, & troubleshoot P. S. filter ☐
   - RC ☐
   - Choke input ☐
   - TT type ☐
7. Understand & troubleshoot regulators ☐
8. Understand theory & test transistors ☐
9. Construct & troubleshoot the following transistor circuits:
   - CE ☐
   - CB ☐
   - CC ☐
10. Design, construct, & troubleshoot amplifier circuits for vacuum tubes & transistors: ☐
    - Voltage amp ☐
    - Push-pull power ☐
    - Single-ended power ☐
11. Design, construct, troubleshoot oscillator circuits:
    - Colpitts ☐
    - Armstrong ☐
    - Tunnel diode ☐
    - Clapp ☐
    - Multivibrators ☐

TV Theory

1. Clean & adjust B & W TV ☐
   - Color TV ☐
2. Remove & install tuner ☐
   - CRT ☐
3. Trace signal through TV receiver ☐
4. Troubleshoot & repair TV circuits ☐
5. Alignment of AM & FM radio ☐
6. Troubleshoot & repair AM & FM radio ☐
7. Install, troubleshoot, & repair:
   - Tape recorders ☐
   - Tape decks ☐
   - Record players ☐
   - Misc. elec. equip. ☐

Work Experience

1. _____
2. _____
3. _____
4. _____
5. _____

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: RESIDENTIAL WIRING
YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Introduction to Electricity

SELECTED INDIVIDUAL TASKS:

1. Use common hand tools [ ]
2. Use the following power tools:
   - sabre saw [ ]
   - drill [ ]
   - power saw [ ]
   - impact tools [ ]
   - stud gun [ ]
   - chasis punch [ ]
3. Interpret drawings:
   - schematic [ ]
   - wiring [ ]
   - pictorial [ ]
4. Use meters:
   - Vom. [ ]
   - Elec. tester [ ]
5. Understand atomic theory [ ]
6. Know & apply ohms law [ ]
7. Understand:
   - Series circuits [ ]
   - Parallel circuits [ ]
8. Know D-C motor principles [ ]

A-C Theory

1. Understand single & 3 ø generation [ ]
2. Know and apply the following circuit theory:
   - RC [ ]
   - RL [ ]
   - RLC [ ]
   - Power factor [ ]

Wiring

1. Compute circuit requirements [ ]
2. Layout typical house [ ]
3. Drill & pull wires [ ]
4. Rough in boxes [ ]
5. Install service entrance [ ]
6. Install & make in panel [ ]
7. Identify common wiring materials [ ]
8. Install devices [ ]
9. Install fixtures [ ]
10. Install appliances [ ]
11. Compute electric heat requirements [ ]
12. Install electric heat [ ]
13. Install signal circuits [ ]
14. Install wp. outlets [ ]
15. Oil burner theory [ ]
16. Install switch circuits
    - Sp. [ ]
    - 3-way [ ]
    - 4-way [ ]
    - Split circuit [ ]
16. Finish - Install covers [ ]
17. Test and trouble shoot defective circuits [ ]
18. Estimate jobs [ ]

Work Experience

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
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FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME_____ PROGRAM: HEALTH OCCUPATIONS
YEAR OF GRADUATION_____ DATE TRANSMITTED:_____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

I: Asepsis

SELECTED INDIVIDUAL TASKS:

1. Handwashing techniques ☐
2. Preparation of isolation unit ☐
3. Putting on/removing mask & gown ☐
4. Transfer of contaminated articles ☐
5. Terminal cleaning of patient unit ☐
6. Prevention of bedsores (bedcradle sheepskin) ☐
7. Assist in pressing ☐
8. Assist in emollient bath ☐
9. Assist in post mortem care ☐

II: Bed Making/Body Mechanics

1. Make unoccupied closed bed ☐
2. Make unoccupied open bed ☐
3. Make occupied bed ☐
4. Make surgical bed ☐
5. Safe operation of hospital beds ☐
6. Turn bed patient toward you ☐
7. Turn bed patient away from you ☐
8. Assist patient to sitting position ☐
9. Assist patient to chair ☐
10. Assist patient to wheelchair ☐
11. Assist patient to walk ☐
12. Use of footboard ☐

III: Patient Hygiene

1. Give a bed bath ☐
2. Assist patient in shower ☐
3. Assist patient in tub ☐
4. Assist patient in sitz bath ☐
5. Give alcohol sponge bath ☐
6. Oral hygiene (teeth, dentures, swabs) ☐
7. Hair care ☐
8. Shave helpless patient ☐
9. Give back rub ☐
10. Give and receive bedpan and urinal ☐
11. Assist in catheter care ☐

IV: Patient Contact

1. AM care ☐
2. PM care ☐
3. Admit patient ☐
4. Transfer patient ☐
5. Discharge patient ☐
6. Check patient food ☐
7. Prepare food tray ☐
8. Feed helpless patient ☐
9. Assist in physical examination ☐
10. Assist in oxygen therapy ☐

V: Vital Signs/Specimens

1. Take temp. - oral ☐
2. Take temp. - rectal ☐
3. Take temp. - axillary ☐
4. Take pulse - radial ☐
5. Take respiration ☐
6. Take blood pressure ☐
7. Measure intake (mouth, IV) ☐
8. Measure output (urine, stool, vomitus) ☐
9. Collect specimen - urine ☐
10. Collect specimen - sputum ☐
11. Collect specimen - stool ☐
12. Test urine - clinitest ☐
13. Test urine - acetest ☐

VI: Communication

1. Enter T.P.R. Blood pressure ☐
2. Chart intake and output on chart ☐
3. Enter nurse's notes ☐
4. Receive and record telephone messages ☐
5. Participation in precare discussion ☐
6. Participation in postcare discussion ☐

VII: Dietary Equipment

1. Sanitary procedures ☐
2. Operation of large equipment:
   a. steamer ☐
   b. convection oven ☐
   c. freezers ☐
   d. mixers, etc ☐
   e. dishwasher ☐
   f. food carts (hot) ☐
   g. conveyor carts ☐
   h. conveyor belt ☐
3. Operation of small equipment ☐

VIII: Meal Preparation

1. Sanitary procedures ☐
2. Quantity recipe cards ☐
3. Weights and measures ☐
4. Portion control (in prep) ☐
5. Food procurement ☐
6. Stock rotation ☐
7. Rotation menus ☐
8. Allowance for changes ☐

IX: Meal Serving

1. Sanitary procedures ☐
2. Portion control (hot and cold) ☐
3. Knowledge of diets:
   a. regular ☐
   b. special ☐
   c. isolation ☐
4. Trays - correct ☐
5. Dispatch of food carts ☐
6. Retrieval of food carts ☐
7. Nourishments ☐
8. Special functions ☐

X: Housekeeping

1. Sanitary procedures ☐
2. Use of storage closet ☐
3. Use of dust mop ☐
4. Use of vacuum system ☐
5. Use of germicides ☐
6. Use of mop & bucket ☐
7. Use of shampooer ☐
8. Use of washing mach. ☐
9. Use of dryers ☐
10. Use of mangler ☐
11. Linen storage ☐
12. Linen distribution ☐
13. Daily cleaning of pt. unit ☐
14. Terminal cleaning of pt. unit ☐
15. Isolation room technique ☐
16. Halls, reception rooms, elevators, etc. ☐

XI: Physical Therapy

1. Basic principles ☐
2. Assist - Hospital ☐
   - Crotched Mtn. ☐
   - Visiting Nurses Association ☐

Work Experience

1. _____ ☐
2. _____ ☐
3. _____ ☐
4. _____ ☐
5. _____ ☐
6. _____ ☐

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as lateness	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
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FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: VOCATI[illegible] OOD SERVICE
YEAR OF GRADUATION _____ DATE TRANSMITTED _____

EVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

School Kitchen Lab.

SELECTED INDIVIDUAL TASKS:
Areas of:

1. Work relationships [ ]
2. Task analysis [ ]
3. Job descriptions [ ]
4. Sanitation when preparing & serving food [ ]
5. Work habits [ ]
6. Personal characteristics [ ]
7. 6 kitchen lab reports [ ]

Human Relations & Communication

1. Identify levels of training & experience [ ]
2. Develops & maintains good personal & public relations [ ]
3. Prepare personal data sheet [ ]
4. Take part in interview & tour of facilities [ ]
5. Checklist for grooming for job [ ]
6. Personal characteristics--work habits [ ]
7. Participate in F. S. local survey [ ]
8. Works cooperatively with employees [ ]

Sanitation

1. Prevent food spoilage [ ]
2. Demonstrate proper tech. handling:
   - food [ ]
   - equipment [ ]
   - utensils [ ]
3. Know 3 causes of F.B. disease [ ]
4. Know dishwashing procedures:
   - By machine [ ]
   - By hand [ ]
5. Practice correct procedures for cleaning & maintenance of:
   - Work areas [ ]
   - Walls, floors [ ]
   - Garbage [ ]
   - Insect/rodent cont. [ ]
6. Practice sanitation practices required when serving food [ ]

Safety

1. Report safety hazards [ ]
2. Develop healthy work habits [ ]
3. Use fire-fighting equipment [ ]
4. List safety regulations for food est. [ ]
5. Identify causes of accidents & injuries
   - Strains [ ]
   - Cuts [ ]
   - Burns [ ]
   - Falls [ ]
   - Kitchen fires [ ]
   - Accidents with equipment [ ]

Equipment

1. Sanitation & safety in use of:
   - Coffee urn [ ]
   - Food warmer [ ]
   - Mixer attachments [ ]
   - Refrigerators [ ]
   - Freezers [ ]
   - Deep fat fryer [ ]
   - Grill [ ]
   - Steam table [ ]
   - Trunnion kettle [ ]
   - Steam cooker [ ]
   - Steam boiler [ ]
   - Convex oven [ ]
   - Slicer [ ]
   - Small equipment [ ]

Basic Preparation

1. Follow recipes (steps) [ ]
2. Adjust recipes (size) [ ]
3. Set up standardized recipes [ ]
4. Accuracy in measuring [ ]
5. Portion control
   - Use kitchen spring scales [ ]
   - Use of balance scales [ ]

Meal Preparation

1. Beverages ☐
2. Cakes ☐
3. Cookies ☐
4. Cheese dish ☐
5. Casserole dishes ☐
6. Desserts ☐
7. Egg cookery ☐
8. Fish ☐
9. Fruit ☐
10. Meat ☐
11. Pie & pastry ☐
12. Poultry ☐
13. Quick bread ☐
14. Salads ☐
15. Sandwiches ☐
16. Soup ☐
17. Vegetables ☐
18. Yeast breads ☐

Nutrition

1. Importance of nutrition ☐
2. Dietary needs in disease ☐
3. Food nutrients
   - Protein ☐
   - Fats ☐
   - Carbohydrates ☐
   - Vitamins ☐
   - Minerals ☐
4. Nutritional practices in F. S. ☐

Menu Planning

1. Basic principles of menu planning ☐
2. Menu terms ☐
3. Menus for types of F.S.
   - Waiter-waitress service ☐
   - Fountain service ☐
   - Counter or cafeteria ☐
   - Tray line for hosp. ☐
   - School lunch--Type A ☐
4. Recognize & perform different types of table service
   - American ☐
   - English ☐
   - French ☐
   - Russian ☐
   - Buffet ☐
   - Banquet ☐

Food Purchasing

1. Recordkeeping--gross receipts, net profit ☐
2. Checking invoices ☐
3. Revolving inventory ☐
4. Take inventory--stock food ☐
5. Pricing inventory ☐
6. Check prices from competing firms ☐

Managing

1. Participates in planning menus ☐
2. Estimates amount of food required ☐
3. Plans for prep. & portioning foods ☐
4. Requisitions or order food ☐
5. Compute cost per serving of food ☐

Work Experience

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as lateness	Record Is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
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FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: SECRETARIAL OFFICE PROCEDURES
YEAR OF GRADUATION _____ DATE TRANSMITTED: _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Basic Typewriting Procedures

SELECTED INDIVIDUAL TASKS:

1. Operate:
   - IBM Selectric [ ]
   - IBM Standard [ ]
   - IBM Selectric II [ ]
   - IBM Executive [ ]
   - Adler Electric [ ]
2. Proper handling [ ]
   Selects supplies [ ]

Letter Production Techniques

1. Letter parts [ ]
2. Proper margins [ ]
3. Punctuation forms [ ]
4. Letter styles [ ]
5. Envelopes [ ]
6. Erasures [ ]
7. Proofreading [ ]
8. Mailable letters from:
   - straight copy [ ]
   - rough draft [ ]
9. Stationery [ ]

Mail Services

1. Classify mail [ ]
2. Parcel specifications [ ]
3. Special services [ ]
4. Postage [ ]
5. Incoming mail [ ]
6. Outgoing mail [ ]
7. ZIP codes [ ]
8. Special service notations [ ]
9. Bulk mail regulations [ ]

Typewriting Production Pbms.

1. Centering [ ]
2. Manuscripts, reports [ ]
3. Outlines [ ]
4. Footnotes [ ]
5. Bibliographies [ ]
6. Labels [ ]
7. Half-spacing [ ]
8. Fill-ins [ ]
9. Justify [ ]
10. Financial reports [ ]
11. Legal documents [ ]
12. Duplicating masters [ ]
13. Stencils [ ]
14. Offset masters [ ]
15. Copies needed [ ]
16. 4-page program using stylii [ ]

Dictation & Transcription

1. Shorthand
   - fluency [ ]
   - speed [ ]
   - clarity [ ]
2. Transcription skills
   - vocabulary [ ]
   - spelling [ ]
   - letter placement [ ]
   - mailability [ ]
   - typing speed [ ]
   - figures [ ]
   - reference books [ ]

Telephone

1. Techniques [ ]
2. Incoming calls [ ]
3. Local outgoing calls [ ]
4. Long distance calls using DDD [ ]
5. Long distance calls using operator [ ]
6. Transferring calls [ ]
7. Directory [ ]
8. Courtesy [ ]
9. Speech [ ]
10. Efficiency [ ]
11. PBX switchboard [ ]
12. Multi-button switchboard [ ]
13. Special telephone services [ ]

Duplicating Processes

1. Fluid duplicating [ ]
2. Stencil duplicating [ ]
3. Offset duplicating [ ]
4. Copier [ ]

Office Machines

1. 10-key adding listing [ ]
2. Full keyboard [ ]
3. Electronic calculator [ ]
4. Rotary calculator [ ]
5. Collator [ ]
6. Folding machine [ ]

Travel & Transportation

1. Various travel services
   - omestic [ ]
   - international [ ]
2. Expense reports [ ]
3. Itineraries [ ]
4. Reservatic [ ]
5. Travel funds [ ]

Telegraph

1. Correct service ☐
2. Word count
   - domestic ☐
   - international ☐
3. Systems ☐
4. Special services ☐
5. Various international services ☐

Filing Rules

1. Alphabetic filing
   - individual ☐
   - firm ☐
   - special ☐
2. Subject filing
   - subject division ☐
   - subject numeric ☐
3. Numeric filing
   - terminal-digit ☐
4. Geographic ☐
5. Chronological filing ☐

Filing Procedures

1. Routine ☐
2. Familiar with:
   - filing supplies ☐
   - equipment ☐
   - charge-out ☐
   - disposal of old files ☐
   - storage of data ☐
3. Systems ☐

Internal Communications

1. Set up written comm. ☐
2. Within a company ☐
3. Between branches ☐

Transcribing Machines

1. Operate ☐
2. Mailable copy ☐

Writing Business Letters

1. Compose business letters ☐
2. Complete form letters ☐

Payroll System

1. Basis of payment ☐
2. Records of time ☐
3. Figuring hours worked ☐
4. Figuring gross pay ☐
5. Deductions ☐
6. Computing net pay ☐
7. Employees earnings rcd. ☐
8. Payroll journal ☐
9. Disbursing payroll ☐

Work Experience

1. _____
2. _____
3. _____
4. _____
5. _____

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: CLERICAL OFFICE PROCEDURES
YEAR OF GRADUATION _____ DATE TRANSMITTED: _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Introduction To Business Office

SELECTED INDIVIDUAL TASKS:

1. Acquainted with office world [ ]
2. Know opportunities available to clerical wkrs. [ ]
3. Know general qualifications required for office work [ ]
4. Recognize rewards & promotion possibilities in office work [ ]

Machine Computing Methods

1. Full-key adding listing [ ]
2. 10-key adding listing [ ]
3. Electronic calculator [ ]
4. Rotary calculator [ ]
5. Collator [ ]
6. Folding machine [ ]
7. Punched-tape machine [ ]
8. Punched-card machine [ ]
9. Magnetic & optical scanning machine [ ]

Basic Typewriting Procedures

1. Can operate efficiently:
   - IBM Selectric [ ]
   - IBM Standard [ ]
   - IBM Selectric II [ ]
   - IBM Executive [ ]
   - Adler Electric [ ]
2. Practices proper handling of all typewriters [ ]
3. Selects supplies [ ]

Letter Production Techniques

1. Letter parts [ ]
2. Proper margins [ ]
3. Punctuation forms [ ]
4. Letter styles [ ]
5. Envelopes [ ]
6. Erasures [ ]
7. Proofreading skills [ ]
8. Mailable letters from:
   - straight copy [ ]
   - rough draft [ ]
9. Stationery [ ]

Special Type Prod. Pbms.

1. Centering [ ]
2. Manuscripts, reports [ ]
3. Outlines [ ]
4. Footnotes [ ]
5. Bibliographies [ ]
6. Labels [ ]
7. Half-spacing [ ]
8. Fill-ins [ ]
9. Justify [ ]
10. Financial reports [ ]
11. Legal documents [ ]
12. Duplicating masters [ ]
13. Stencils [ ]
14. Offset masters [ ]
15. Copies needed [ ]
16. 4-page program using stylii [ ]

Telephone

1. Telephone technique [ ]
2. incoming calls [ ]
3. Local outgoing calls [ ]
4. Long distance calls using DDD [ ]
5. Long distance calls using operator [ ]
6. Transferring calls [ ]
7. Directory [ ]
8. Courtesy [ ]
9. Speech [ ]
10. Efficiency [ ]
11. PBX switchboard [ ]
12. Multi-button switchboard [ ]
13. Special telephone services [ ]

Purchases

1. Budgeting [ ]
2. Requesting [ ]
3. Ordering [ ]
4. Receiving [ ]
5. Accounts payable [ ]

Internal Communications

1. Set up written comm. [ ]
2. Within a company [ ]
3. Between branches [ ]

Duplicating Processes

1. Fluid duplicating [ ]
2. Stencil duplicating [ ]
3. Offset machine [ ]
4. Copier [ ]

Transcribing Machines

1. Operate [ ]
2. Type mailable copy [ ]

Business Writing

1. Compose business ltrs. [ ]
2. Complete form letters [ ]

Sales

1. Contacting customers [ ]
2. Receiving orders [ ]
3. Billing [ ]
4. Accounts receivable [ ]

Filing Rules

1. Alphabetic filing
   - individual ☐
   - firm ☐
   - special ☐
2. Subject filing
   - subject division ☐
   - subject numeric ☐
3. Numeric filing
   - terminal-digit ☐
4. Geographic filing ☐
5. Chronological filing ☐

Routine Cashiering Activities

1. Familiar with handling incoming funds
   - making change ☐
   - cash discount ☐
   - recording ☐
   - cashing checks ☐
2. Familiar with handling outgoing funds
   - authorization ☐
   - check writing ☐
   - recording ☐

Mail Services

1. Classify mail ☐
2. Parcel specifications ☐
3. Special services ☐
4. Postage needed ☐
5. Incoming mail ☐
6. Outgoing mail ☐
7. ZIP codes ☐
8. Special service notations ☐
9. Bulk mail regulations ☐

Filing Procedures

1. Filing routine ☐
2. Familiar with:
   - filing supplies ☐
   - filing equipment ☐
   - charge-out ☐
   - disposal of old files ☐
   - storage of data ☐
3. Filing systems ☐

Special Cashiering Activities

1. Refunds & allowances ☐
2. Credit cards ☐
3. Pricing charts ☐
4. Handling checks ☐
5. Petty cash ☐
6. Reconciling bank statement ☐

Payroll Systems

1. Basis of payment ☐
2. Records of time ☐
3. Figuring hours worked ☐
4. Figuring gross pay ☐
5. Deductions ☐
6. Computing net pay ☐
7. Employees earnings rcd. ☐
8. Payroll journal ☐
9. Disbursing payroll ☐

Shipping Systems & Procedures

1. Preparation of goods ☐
2. Method of shipment ☐
3. Reference books ☐
4. Shipping papers ☐
5. Dispatching ☐
6. Other shipping functions ☐

Telegraph

1. Correct service ☐
2. Word count
   - domestic ☐
   - international ☐
3. Systems ☐
4. Special services ☐
5. Various international services ☐

Work Experience

1. _____
2. _____
3. _____
4. _____
5. _____

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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PERFORMANCE SKILLS PROFILE

STUDENT'S NAME_____ PROGRAM: ACCOUNTING I & II
YEAR OF GRADUATION_____ DATE TRANSMITTED_____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Accounting Cycle

SELECTED INDIVIDUAL TASKS:

1. Starting accounting system:
   - Preparation of a balance sheet [ ]
2. Journalize entries using general journal [ ]
3. Post general journal entries [ ]
4. Preparation of:
   - 6-column work sheet [ ]
   - Income statement [ ]
   - Balance sheet [ ]
   - Closing the ledger [ ]

Use of Journals

Recording transactions in:

1. Combination journal [ ]
2. Purchases journal [ ]
3. Cash payments journal [ ]
4. General journal [ ]
5. 4-column general jrnl. [ ]
6. Sales journal [ ]
7. Cash receipts journal [ ]

End/Yr. Financial Statements

Merchandising business:

1. Preparation of:
   - 8-column work sheet [ ]
   - Income statement [ ]
   - Capital statement [ ]
   - Balance sheet [ ]
   - Recording adjusting entries [ ]
   - Recording closing entries [ ]

Partnerships

Recording of:

1. Formation of a partnership [ ]
2. Admission of a new partner [ ]
3. Liquidation of a partner [ ]
4. Methods of dividing income [ ]
5. End-of-year work:
   - Work sheets [ ]
   - Financial statements [ ]
   - Adjusting & closing entries [ ]
   - Post-closing trial balance [ ]
   - Reversing entries [ ]
   - Reporting of partner's federal income tax [ ]

Corporation

Transactions concerning:

1. Formation of corporation [ ]
2. Purchase of a business by a corporation [ ]
3. Sale of additional capital stock [ ]
4. Transfer of stock [ ]
5. Corporate bonds [ ]
6. Preparation of corporate financial reports:
   - Work sheet [ ]
   - Income statement [ ]
   - Capital statement [ ]
   - Balance sheet [ ]
   - Adjusting & closing entries [ ]
   - Post-closing trial balance [ ]
   - Reversing entries [ ]

Bad Debts

1. Establish allowance for bad debts account [ ]
2. Reporting of bad debts expense & allowance for bad debts on financial statements [ ]
3. Writing off uncollectible accounts
   - direct write-off method [ ]
   - allowance method [ ]
4. Recording of adjusting entries [ ]
5. Calculating accounts receivable turnover [ ]

Voucher System	Inventory	Budgetary Control System
1. Preparing vouchers ☐	1. Determining the quantity of merchandise inventory ☐	1. Designing budgets ☐
2. Recording in voucher register ☐	2. Pricing merchandise inventory ☐	2. Using past records to obtain data for budgeting ☐
3. Payment of vouchers ☐	3. Determining rate of turnover ☐	3. Planning income & expense budgets ☐
4. Using the check register ☐		4. Planning a cash budget ☐

Payroll	Data Processing In Acct.	Cash Register System
1. Preparation of payroll ☐	1. Comparison of manual, mechanical, & automatic processes in accounting ☐	1. Recording transactions ☐
2. Payment of payroll ☐	2. Preparing & reading punch cards ☐	2. Proving cash ☐
3. Recording payroll ☐	3. Preparation of flow chart of an accounting procedure ☐	3. Using subsidiary ledgers ☐
4. Reporting & paying payroll taxes & liabilities ☐		4. Establishing, proving, & replenishing petty cash fund ☐
5. Preparation of payroll tax reports ☐		

Depreciation	Notes	Special Problems In Acct.
1. Recording the purchases of fixed assets ☐	1. Recording notes receivable, notes payable, & interest on notes ☐	Recording of:
2. Determining amounts of depreciation expense ☐	2. Dishonoring notes receivable ☐	1. Installment sales ☐
3. Keeping of fixed asset records ☐	3. Discounting notes receivable ☐	2. Purchases of used merchandise accepted as trade-in ☐
4. Valuation of fixed assets ☐	4. Using notes receivable register ☐	3. Repossessed merchandise ☐
5. Adjustments for depreciation ☐	5. Issuing & payment of notes payable ☐	4. COD sales ☐
6. Disposing of fixed assets ☐	6. Recording of drafts ☐	5. Consignment transactions ☐
7. Recording the depletion of a fixed asset ☐	7. Recording of trade acceptances ☐	
8. Reporting of fixed assets & depreciation on financial statements ☐		

Taxes	Income Recd. In Advance	Prepaid Expense/Accrued Expense
Recording of entries involving: Sales taxes ☐ Property taxes ☐	Recording of: 1. Income received in advance as liabilities ☐ 2. Income received in advance as income ☐ 3. Accrued income ☐	Recording of: 1. Prepaid expense as assets ☐ 2. Prepaid expense as expense ☐ 3. Accrued expenses ☐

Analysis Of Financial Statements

1. Preparation of comparative financial statements ☐
2. Analysis of financial statements ☐

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusual Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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Taxes	Income Recd. In Advance	Prepaid Expense/Accrued Expense
Recording of entries involving: Sales taxes ☐ Property taxes ☐	Recording of: 1. Income received in advance as liabilities ☐ 2. Income received in advance as income ☐ 3. Accrued income ☐	Recording of: 1. Prepaid expense as assets ☐ 2. Prepaid expense as expense ☐ 3. Accrued expenses ☐

Analysis Of Financial Statements

1. Preparation of comparative financial statements ☐
2. Analysis of financial statements ☐

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
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JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
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FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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BUSINESS DEPARTMENT

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ VOCATIONAL PROGRAM: MACHINE TOOL
YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Safety

SELECTED INDIVIDUAL TASKS:

1. Shop regulations [ ]
2. General housekeeping [ ]
3. OSHA regulations [ ]
4. Clothing [ ]
5. Eye protection [ ]
6. Fire hazards & equip. [ ]

Crib (Tool)

1. Sockets [ ]
2. Open end wrenches [ ]
3. Box end wrenches [ ]
4. Combination wrenches [ ]
5. Torque wrenches [ ]
6. Allen wrenches [ ]
7. Screwdrivers [ ]
8. Issue tools [ ]
9. Check condition of returned tools [ ]
10. Use inventory cards [ ]

Inspection/Measurement

1. Micrometer [ ]
2. Vernier caliper [ ]
3. Depth mike [ ]
4. Indicators [ ]
5. Gauge blocks [ ]
6. Sine bar setups [ ]
7. Telescoping gauge [ ]
8. Vernier height gauge [ ]
9. Surface plate [ ]
10. Calipers [ ]
11. Protractor [ ]
12. Thread pitch gauge [ ]

Specification Sheets

1. Sketching [ ]
2. Sectional prints [ ]
3. Orthographic prints [ ]
4. Procedure sheets [ ]
5. Abbreviations [ ]
6. Tolerances [ ]

Bench & Floor Work

1. Filing [ ]
2. Drawfile [ ]
3. Chisel work [ ]
4. Hand hacksaw [ ]
5. Power hacksaw [ ]
6. Tapping & die [ ]
7. Hand ream [ ]
8. Assemble [ ]
9. Bench polish [ ]
10. File test [ ]

Drill Press

1. Speeds [ ]
2. Center drill [ ]
3. Drilling [ ]
4. Drill pointing [ ]
5. Reaming [ ]
6. Countersink [ ]
7. Counterbore [ ]
8. Lapping [ ]
9. V block [ ]
10. Jigs [ ]

Vertical Miller

1. Speeds [ ]
2. Drill [ ]
3. Bore [ ]
4. Fly cutter [ ]
5. End mill [ ]
6. Index [ ]
7. Inspection [ ]
8. Layout [ ]
9. V block [ ]
10. Step blocks [ ]
11. Dial indicator [ ]
12. Collets [ ]
13. Safety [ ]
14. Jigs [ ]
15. Square A block [ ]
16. Lubrication [ ]

Heat Treat

1. Operate:
   - Heat treat furnace [ ]
   - Tempering ovens [ ]
   - Quenching equipment [ ]
2. Regulate temperatures [ ]
3. Control heating cycles [ ]
4. SAE identification [ ]

Band Saw

1. Speeds [ ]
2. Blade types [ ]

Grinding

1. Surface/Cylindrical
   - Safety ☐
   - Dress & adjust grinding wheels ☐
   - Speeds and feeds ☐
   - Flat & parallel ☐
   - Shoulder on angle iron ☐
   - Forms ☐
   - Arbors & vices ☐
   - Jigs ☐
   - Cutter grinding ☐
   - Lubrication ☐
2. Pedestal
   - Safety ☐
   - Dress & adjust grinding wheel ☐
   - Wheel selection ☐
   - Dressing ☐
   - Drill sharpening ☐
   - Metal identification ☐
   - Lathe tool grinding ☐
   - Snagging ☐

Lathe

1. Safety ☐
2. Center drill ☐
3. Spot drill ☐
4. Facing ☐
5. R. turn ☐
6. Finish turn ☐
7. Square shoulder ☐
8. Knurling ☐
9. Cutting speeds ☐
10. Feed speeds ☐
11. Lubrication ☐
12. Tool bits
    - Facing ☐
    - Turning ☐
    - Cutting ☐
    - Necking ☐
    - Forming ☐
    - Threading ☐
13. Collets ☐
14. Drilling ☐
15. Reaming ☐
16. Filing ☐
17. Polishing ☐
18. Bore straight hole ☐
19. Bore tapered hole ☐
20. Taper turn
    - Compound ☐
    - Tail stock ☐
    - Taper attachment ☐
21. Faceplate work ☐
22. Form turning ☐
23. Chuck work
    - 1-3 jaw universal ☐
    - 2-4 jaw universal ☐

Co-op Work Experience

1. _____ Level I
2. _____ " I
3. _____ " I
4. _____ " I
5. _____ Level II
6. _____ " II
7. _____ " II
8. _____ " II
9. _____ Level III
10. _____ " III

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
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FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: GRAPHIC ARTS (Offset)
YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Cold Type Composition

SELECTED INDIVIDUAL TASKS:

1. Recognition of:
   - 4 major type faces ☐
   - good camera copy ☐
2. On Varityper, understand & be able to:
   - Set up ☐
   - Insert fonts ☐
   - Operation of ☐
   - Change ribbons ☐
   - Justification of copy ☐
3. For Headliner, understand & be able to:
   - Set up ☐
   - Mix chemicals for ☐
   - Fill developing tank ☐
   - Make ready a font ☐
   - Change fonts ☐
   - Set posi. & neg. on ☐
4. Using Chartpak products, Paste-on & rub-on ☐
5. Use & eval. of prev. ptd. mat. for copy/line & hftn ☐

Darkroom Procedures--Wet & Dry

1. Identification of film ☐
2. Base vs. emulsion sides ☐
3. Types of film, ortho, pan ☐
4. Screen iden. and use ☐
5. Filter iden. and use ☐
6. Storage & care of film ☐
7. Construction of film ☐
8. Neg. vs. Pos. and use ☐
9. Camera setup for line work ☐
10. Focusing w/ground glass ☐
11. Enlarging and reducing ☐
12. Positioning of lights ☐
13. Vacuum back operation ☐
14. Spg.loaded cpyhldr oper. ☐
15. Lens adjustment & why ☐
16. Timing of exposure ☐
17. Proper exposure for line ☐
18. Proper exp. for halftone ☐
19. Use of proportional scale ☐
20. Stor. of neg. & positives ☐
21. Use of linen tester or magnifier ☐
22. Combination exposures ☐

Wet Side of Darkroom Operation

1. Bring temp. control sink to operation ☐
2. Care of sink ☐
3. Storage of materials, chemicals, etc. ☐
4. Measuring of chemicals ☐
5. Exp. of "A" & "B" dev. ☐
6. Hypo & its use & life ☐
7. 4-tray pro. of devel. ☐
8. Wash neg. & positives ☐
9. Proper dev. tech. for out-of-the-ordinary situations/poor copy ☐
10. Safe lighting tech. ☐
11. Proper cleanup proced. ☐
12. Safety proced. for all darkroom work ☐
13. Proper drying of film after exposure ☐
14. Proper handling of exposed film ☐

Platemaking

1. Different types plates ☐
2. Prop. hand. of plates, before, after & duc.exp ☐
3. Operation of platemaker ☐
4. Changing of carbon arcs ☐
5. Proper exp. time, etc. ☐
6. Care of platemaker ☐
7. Safety precautions/ptemk ☐
8. Proper devl. of plates ☐
9. Use & stor. of chemicals ☐
10. Prop. washing plates w/ prop. mat. to prevent dmg ☐
11. Prop. meth. of plate coating for storage ☐

Inks & Their Uses

1. Regular ☐
2. Fast drying ☐
3. Black vs. colors ☐
4. Transparent vs. opaque ☐
5. Toners ☐
6. Varnishes & their uses ☐
7. Driers, types & uses ☐
8. Crystalization causes and cures ☐
9. Offseting & preventions ☐

Safety

1. Safety measures for entire shop ☐

Stripping Techniques

1. Introduction of tools employed ☐
2. Use of light table ☐
3. Use of "T" square & triangles ☐
4. Proper measuring techniques ☐
5. Proper positioning of "mask" on table ☐
6. Identification of proper masking material ☐
7. Use of various types of tapes ☐
8. Use of various types of marking devices ☐
9. Use of various cutting tools, razor blades, X-acto knives, etc. ☐
10. Scribing with various instruments ☐
11. Window construction on masks for double exp. ☐
12. Proper handling of masks during use & for stor. ☐
13. Proper opaquing techniques ☐
14. Proper opaquing materials, etc. ☐

Bindery Skills

1. Stock handling ☐
2. Fanning & counting stock ☐
3. Recognition of various kinds of stock ☐
4. Proper packing procedures ☐
5. Proper unpacking proced. ☐
6. Operation of automatic cutter ☐
7. Safety around cutter ☐
8. Changing blades or knives for cutter ☐
9. Care of cutting knives ☐
10. Storage of cutting knives ☐
11. Trimming of booklets ☐
12. Figuring stock, etc. ☐
13. Padding, collating of paper ☐
14. Stitching booklets & flat stock ☐
15. Care of stitcher & wire changing ☐
16. Paper drilling & care of machine ☐
17. Changing drills ☐
18. Round cornering & slitting ☐
19. Folding, single & multiple ☐
20. Scoring & perforating on folder ☐
21. Care of folder ☐

Offset Press Operation & Care

1. Machine features ☐
2. Feeder & register board ☐
3. Adjustment of feeder ☐
4. Adjustment of register board ☐
5. Machine controls ☐
6. Inking unit operation and care ☐
7. Replex system, care & operation ☐
8. Ink unit ☐
9. Care & operation of ink unit ☐
10. Delivery unit ☐
11. Adjustment of delivery unit ☐
12. Registering problems & solutions ☐
13. Printing unit ☐
14. Plate handling on unit ☐
15. Three cylinder knowledge ☐
16. Process principle ☐
17. Plate cylinder, impression cylinder & blanket cylinder ☐
18. Blanket care ☐
19. Blanket affixing & removal ☐
20. Problems & probable causes & solutions ☐

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as lateness	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Invariably Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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GENERAL HIGH SCHOOL
BUSINESS DEPARTMENT

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: HORTICULTURE
YEAR OF GRADUATION _____ DATE TRANSMITTED: _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Greenhouse Management

SELECTED INDIVIDUAL TASKS:

1. Start seedlings ☐
2. Transplant seedlings ☐
3. Start cuttings ☐
4. Transplant cuttings ☐
5. Fertilize with:
   - solid fertilizers ☐
   - liquid fertilizers
     - hozon method ☐
     - proportioner method ☐
6. Mix soil ☐
7. Sterilize soil:
   - steam ☐
   - electrically ☐
   - chemically ☐
8. Pesticides:
   - aerosol ☐
   - spray ☐
   - dust ☐
   - drench ☐
9. Harvesting & shipping cut flowers ☐

Landscape Design/Maintenance

1. Landscape symbols ☐
2. Design principles ☐
3. Use of structures ☐
4. Theme ☐
5. Color and lighting ☐
6. Development of landscape areas
   - public ☐
   - private ☐
   - service & recreation ☐
7. Grading ☐
8. Conditioning soil ☐
9. Supplying drainage ☐
10. Construction of:
    - walks & driveways ☐
    - patios & terraces ☐
    - fences & walls ☐
11. Establishment of lawn for:
    - shady areas ☐
    - semi-shade ☐
    - sunny ☐
    - recreational ☐
    - steep slope ☐
12. Planting trees
    - bare rooted ☐
    - balled & burlapped ☐
13. Protecting trees
    - wrapping ☐
    - staking ☐
14. Planting shrubs ☐
15. Planting flowers
    - annuals ☐
    - biennials ☐
    - perennials ☐
16. Fertilizing
    - lawns ☐
    - trees ☐
    - shrubs ☐
    - flowers ☐

Floral Design & Arrangement

1. How to cut flowers ☐
2. When to cut flowers ☐
3. Charring ☐
4. Hammering ☐
5. Stripping ☐
6. Stemming ☐
7. Design principles
   - containers ☐
   - balance ☐
   - use of greens ☐
   - constructing corsages ☐
   - floral pieces ☐
   - specialty arrangements ☐
   - dried flowers ☐
   - correct use of preservatives ☐

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
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FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

Printed by
Conval High School
Business Department

PROCESS FOR REPORTING STUDENT PROGRESS

ON THE

PERFORMANCE SKILLS PROFILES

GUIDANCE DEPARTMENT WILL:

1. Upon a student's entry into a vocational program (including 2nd-year courses), the instructor will be given a Performance Skill Profile, including student's name, and anticipated year of graduation. This profile includes selected individual tasks representative of the two-year vocational program.

2. At the end of each school year, the guidance department will file the Student Performance Skill Profile in the student's cumulative record.

   Area Vocational Students. Profiles on area vocational students will remain at Con-Val. When the student has completed the vocational program, a copy of the profile will go to the sending school to become part of the student's permanent record.

3. When a student completes the vocational program, the Performance Skill Profile will become part of his permanent record.

4. If a vocational student requests a copy of his Performance Skill Profile to assist him in securing full time, part time, or summer employment, the guidance department will obtain the profile from the vocational teacher and provide necessary copies.

5. Upon request, the guidance department will provide, with student permission, prospective employers with copies of the Student Performance Skill Profile.

6. If a vocational student is seeking admission to a post-secondary school, the guidance department will provide a copy of the Student Performance Skill Profile as part of the educational placement process.

TEACHER WILL:

1. At the end of each marking quarter, the teacher will indicate the student's level of proficiency on each of the selected individual tasks listed. If the student has not been exposed to a unit or particular task, no mark should be recorded.

2. Throughout the school year, the instructor will keep on file the Student Performance Skill Profile for students in his program.

3. At the end of each school year, the instructor will return all Student Performance Skill Profiles to the guidance department.

   Profiles on students completing the two-year sequence should be thoroughly reviewed and updated as they will become part of the student's permanent record.

SUGGESTED USES

FOR THE

STUDENT PERFORMANCE SKILLS PROFILES

1. Provides school with a reporting system for vocational programs which supplements the present grading system.

2. Teachers can send copies of profiles to parents on a quarter-year basis, so parents can "trace" student progress on selected individual tasks.

3. Teachers can readily review individual profile with the student allowing the student to know "where he stands" at any given point in time.

4. Assist school personnel and student in the job placement process.

5. Provides specific information for prospective employers of vocational students in selection process.

6. Provides specific information for employers in the supervision of newly hired "vocational students."

7. Provides a vocational program description which assist school personnel and students in course selection. (Particularly helpful for area vocational centers.)

8. Provides schools with a public relations instrument for accountability.

9. Provides schools with a public relations instrument for information relating to vocational programs.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Statement of the Problem, Purposes and Objectives --

From the first year of the vocational program at Contoocook Valley Regional High School, a behavioral objectives format has been followed. Course outlines are clearly written and continue to be revised. Although the content of the offerings has been well defined, the grading system continues to be a rather traditional format of As, Bs, Cs, etc. A more concise and efficient method of reporting student progress and skills level needs to be developed and implemented.

The purpose of the project can be summarized by stating the objectives listed in chapter 1.

The vocational guidance counselor assisted by the vocational staff, will develop criterion referenced profiles for each vocational program being taught at Contoocook Valley Regional High School.

1. Building Construction
2. Vocational Drafting
3. Electronics
4. Residential Wiring
5. Health Occupations
6. Food Service
7. Secretarial Office Procedures
8. Clerical Office Procedures
9. Accounting
10. Machine Tool Processes
11. Graphic Arts
12. Horticulture

Profiles from each of the 12 programs include selected individual tasks which hi-light a student's ability in the vocational program pursued and work habit comments such as attendance, flexibility and safety consciousness.

The vocational guidance counselor will develop the data collection process whereby information will be recorded on students performance skills profiles.

The vocational guidance counselor will design and have constructed a descriptive flyer of vocational education at Contoocook Valley Regional High School.

Method of Investigation --An initial step taken in this project was contacting several vocational high schools throughout Massachusetts, requesting information on performance type reports. Only one school responded with the information requested.

Meetings were held with personnel people at N.H. Ball Bearing to obtain feedback regarding the project. It was suggested that the school publisize the vocational programs as a first step in the placement process.

A descriptive flyer on vocational education in area vocational center (#14) was developed. Area vocational center (#14) encompasses the schools of Mascenic Regional (New Ipswich), Conant High School (Jaffrey), Wilton-Lyneboro (Wilton), and Contoocook Valley Regional High School (Peterborough).

The next step of the project was the development of the Student Performance Skills Profiles. Basically, selected individual tasks,

depicting what is covered in each of several units covered by the vocational course, were written by the vocational teacher. Conferences involving the teacher, vocational guidance counselor, vocational director and community personnel took place to shape the final product. As each profile took shape, camera ready copy was typed and the profile was printed at Contoocook Valley Regional High School.

The third component of the project is developing the system for reporting progress. Several meetings involving vocational guidance counselor, vocational director and teachers took place. Out of these meetings came a workable system which was field tested using the health occupations profile.

Final rewrite of the process of reporting grades was taken and this form was printed at Contoocook Valley Regional High School.

In addition, a suggested uses of the Student Performance Skills Profile form was written, reviewed and printed at Contoocook Valley Regional High School.

Recommendations -- Dissemination of the profiles is the responsibility of the State Department of Education. 200 copies of each profile is made available to the State Department of Education for this purpose.

It is suggested that each school offering a similar vocational education program, review the profile in light of the course outline, modify these profiles to fit their objectives, and incorporate this reporting system as a supplement to the present method of letter grades.

CONTOOCOOK VALLEY REGIONAL HIGH SCHOOL

ROUTE 202 NORTH

PETERBOROUGH, NEW HAMPSHIRE 03458

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: VOCATIONAL FOOD SERVICE

YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

School Kitchen Lab.

SELECTED INDIVIDUAL TASKS:

Areas of:

1. Work relationships ☐
2. Task analysis ☐
3. Job descriptions ☐
4. Sanitation when preparing & serving food ☐
5. Work habits ☐
6. Personal characteristics ☐
7. 6 kitchen lab reports ☐

Human Relations & Communication

1. Identify levels of training & experience ☐
2. Develops & maintains good personal & public relations ☐
3. Prepare personal data sheet ☐
4. Take part in interview & tour of facilities ☐
5. Checklist for grooming for job ☐
6. Personal characteristics--work habits ☐
7. Participate in F. S. local survey ☐
8. Works cooperatively with employees ☐

Sanitation

1. Prevent food spoilage ☐
2. Demonstrate proper tech. handling:
   - food ☐
   - equipment ☐
   - utensils ☐
3. Know 3 causes of F.B. disease ☐
4. Know dishwashing procedures:
   - By machine ☐
   - By hand ☐
5. Practice correct procedures for cleaning & maintenance of:
   - Work areas ☐
   - Walls, floors ☐
   - Garbage ☐
   - Insect/rodent cont. ☐
6. Practice sanitation practices required when serving food ☐

Safety

1. Report safety hazards ☐
2. Develop healthy work habits ☐
3. Use fire-fighting equipment ☐
4. List safety regulations for food est. ☐
5. Identify causes of accidents & injuries
   - Strains ☐
   - Cuts ☐
   - Burns ☐
   - Falls ☐
   - Kitchen fires ☐
   - Accidents with equipment ☐

Equipment

1. Sanitation & safety in use of:
   - Coffee urn ☐
   - Food warmer ☐
   - Mixer attachments ☐
   - Refrigerators ☐
   - Freezers ☐
   - Deep fat fryer ☐
   - Grill ☐
   - Steam table ☐
   - Trunnion kettle ☐
   - Steam cooker ☐
   - Steam boiler ☐
   - Convex oven ☐
   - Slicer ☐
   - Small equipment ☐

Basic Preparation

1. Follow recipes (steps) ☐
2. Adjust recipes (size) ☐
3. Set up standardized recipes ☐
4. Accuracy in measuring ☐
5. Portion control
   - Use kitchen spring scales ☐
   - Use of balance scales ☐

Meal Preparation

1. Beverages ☐
2. Cakes ☐
3. Cookies ☐
4. Cheese dish ☐
5. Casserole dishes ☐
6. Desserts ☐
7. Egg cookery ☐
8. Fish ☐
9. Fruit ☐
10. Meat ☐
11. Pie & pastry ☐
12. Poultry ☐
13. Quick bread ☐
14. Salads ☐
15. Sandwiches ☐
16. Soup ☐
17. Vegetables ☐
18. Yeast breads ☐

Nutrition

1. Importance of nutrition ☐
2. Dietary needs in disease ☐
3. Food nutrients
   - Protein ☐
   - Fats ☐
   - Carbohydrates ☐
   - Vitamins ☐
   - Minerals ☐
4. Nutritional practices in F. S. ☐

Menu Planning

1. Basic principles of menu planning ☐
2. Menu terms ☐
3. Menus for types of F.S.
   - Waiter-waitress service ☐
   - Fountain service ☐
   - Counter or cafeteria ☐
   - Tray line for hosp. ☐
   - School lunch--Type A ☐
4. Recognize & perform different types of table service
   - American ☐
   - English ☐
   - French ☐
   - Russian ☐
   - Buffet ☐
   - Banquet ☐

Food Purchasing

1. Recordkeeping--gross receipts, net profit ☐
2. Checking invoices ☐
3. Revolving inventory ☐
4. Take inventory--stock food ☐
5. Pricing inventory ☐
6. Check prices from competing firms ☐

Managing

1. Participates in planning menus ☐
2. Estimates amount of food required ☐
3. Plans for prep. & porticning foods ☐
4. Requisitions or order food ☐
5. Compute cost per serving of food ☐

Work Experience

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as lateness	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

PERFORMANCE SKILLS PROFILE

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YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

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2. Task analysis ☐
3. Job descriptions ☐
4. Sanitation when preparing & serving food ☐
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   - Falls ☐
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   - Food warmer ☐
   - Mixer attachments ☐
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   - Deep fat fryer ☐
   - Grill ☐
   - Steam table ☐
   - Trunnion kettle ☐
   - Steam cooker ☐
   - Steam boiler ☐
   - Convex oven ☐
   - Slicer ☐
   - Small equipment ☐

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   - Carbohydrates ☐
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   - American ☐
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   - Russian ☐
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   - Banquet ☐

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1. Recordkeeping--gross receipts, net profit ☐
2. Checking invoices ☐
3. Revolving inventory ☐
4. Take inventory--stock food ☐
5. Pricing inventory ☐
6. Check prices from competing firms ☐

Managing

1. Participates in planning menus ☐
2. Estimates amount of food required ☐
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1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

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JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Almost Self-Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
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SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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CENTRAL HIGH SCHOOL
BUSINESS DEPARTMENT

CONTOOCOOK VALLEY REGIONAL HIGH SCHOOL

ROUTE 202 NORTH
PETERBOROUGH, NEW HAMPSHIRE 03458

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: SECRETARIAL OFFICE PROCEDURES
YEAR OF GRADUATION _____ DATE TRANSMITTED: _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Basic Typewriting Procedures

SELECTED INDIVIDUAL TASKS:

1. Operate:
   - IBM Selectric [ ]
   - IBM Standard [ ]
   - IBM Selectric II [ ]
   - IBM Executive [ ]
   - Adler Electric [ ]
2. Proper handling [ ]
3. Selects supplies [ ]

Letter Production Techniques

1. Letter parts [ ]
2. Proper margins [ ]
3. Punctuation forms [ ]
4. Letter styles [ ]
5. Envelopes [ ]
6. Erasures [ ]
7. Proofreading [ ]
8. Mailable letters from:
   - straight copy [ ]
   - rough draft [ ]
9. Stationery [ ]

Mail Services

1. Classify mail [ ]
2. Parcel specifications [ ]
3. Special services [ ]
4. Postage [ ]
5. Incoming mail [ ]
6. Outgoing mail [ ]
7. ZIP codes [ ]
8. Special service notations [ ]
9. Bulk mail regulations [ ]

Typewriting Production Pbms.

1. Centering [ ]
2. Manuscripts, reports [ ]
3. Outlines [ ]
4. Footnotes [ ]
5. Bibliographies [ ]
6. Labels [ ]
7. Half-spacing [ ]
8. Fill-ins [ ]
9. Justify [ ]
10. Financial reports [ ]
11. Legal documents [ ]
12. Duplicating masters [ ]
13. Stencils [ ]
14. Offset masters [ ]
15. Copies needed [ ]
16. 4-page program using stylii [ ]

Dictation & Transcription

1. Shorthand
   - fluency [ ]
   - speed [ ]
   - clarity [ ]
2. Transcription skills
   - vocabulary [ ]
   - spelling [ ]
   - letter placement [ ]
   - mailability [ ]
   - typing speed [ ]
   - figures [ ]
   - reference books [ ]

Telephone

1. Techniques [ ]
2. Incoming calls [ ]
3. Local outgoing calls [ ]
4. Long distance calls using DDD [ ]
5. Long distance calls using operator [ ]
6. Transferring calls [ ]
7. Directory [ ]
8. Courtesy [ ]
9. Speech [ ]
10. Efficiency [ ]
11. PBX switchboard [ ]
12. Multi-button switchboard [ ]
13. Special telephone services [ ]

Duplicating Processes

1. Fluid duplicating [ ]
2. Stencil duplicating [ ]
3. Offset duplicating [ ]
4. Copier [ ]

Office Machines

1. 10-key adding listing [ ]
2. Full keyboard [ ]
3. Electronic calculator [ ]
4. Rotary calculator [ ]
5. Collator [ ]
6. Folding machine [ ]

Travel & Transportation

1. Various travel services
   - domestic [ ]
   - international [ ]
2. Expense reports [ ]
3. Itineraries [ ]
4. Reservations [ ]
5. Travel funds [ ]

Telegraph

1. Correct service ☐
2. Word count
   - domestic ☐
   - international ☐
3. Systems ☐
4. Special services ☐
5. Various international services ☐

Filing Rules

1. Alphabetic filing
   - individual ☐
   - firm ☐
   - special ☐
2. Subject filing
   - subject division ☐
   - subject numeric ☐
3. Numeric filing
   - terminal-digit ☐
4. Geographic ☐
5. Chronological filing ☐

Filing Procedures

1. Routine ☐
2. Familiar with:
   - filing supplies ☐
   - equipment ☐
   - charge-out ☐
   - disposal of old files ☐
   - storage of data ☐
3. Systems ☐

Internal Communications

1. Set up written comm. ☐
2. Within a company ☐
3. Between branches ☐

Transcribing Machines

1. Operate ☐
2. Mailable copy ☐

Writing Business Letters

1. Compose business letters ☐
2. Complete form letters ☐

Payroll System

1. Basis of payment ☐
2. Records of time ☐
3. Figuring hours worked ☐
4. Figuring gross pay ☐
5. Deductions ☐
6. Computing net pay ☐
7. Employees earnings rcd. ☐
8. Payroll journal ☐
9. Disbursing payroll ☐

Work Experience

1. _____
2. _____
3. _____
4. _____
5. _____

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as lateness	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

Printed by
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Business Department

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: SECRETARIAL OFFICE PROCEDURES
YEAR OF GRADUATION _____ DATE TRANSMITTED: _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Basic Typewriting Procedures

SELECTED INDIVIDUAL TASKS:

1. Operate:
   - IBM Selectric [ ]
   - IBM Standard [ ]
   - IBM Selectric II [ ]
   - IBM Executive [ ]
   - Adler Electric [ ]
2. Proper handling [ ]
3. Selects supplies [ ]

Letter Production Techniques

1. Letter parts [ ]
2. Proper margins [ ]
3. Punctuation forms [ ]
4. Letter styles [ ]
5. Envelopes [ ]
6. Erasures [ ]
7. Proofreading [ ]
8. Mailable letters from:
   - straight copy [ ]
   - rough draft [ ]
9. Stationery [ ]

Mail Services

1. Classify mail [ ]
2. Parcel specifications [ ]
3. Special services [ ]
4. Postage [ ]
5. Incoming mail [ ]
6. Outgoing mail [ ]
7. ZIP codes [ ]
8. Special service notations [ ]
9. Bulk mail regulations [ ]

Typewriting Production Pbms.

1. Centering [ ]
2. Manuscripts, reports [ ]
3. Outlines [ ]
4. Footnotes [ ]
5. Bibliographies [ ]
6. Labels [ ]
7. Half-spacing [ ]
8. Fill-ins [ ]
9. Justify [ ]
10. Financial reports [ ]
11. Legal documents [ ]
12. Duplicating masters [ ]
13. Stencils [ ]
14. Offset masters [ ]
15. Copies needed [ ]
16. 4-page program using stylii [ ]

Dictation & Transcription

1. Shorthand
   - fluency [ ]
   - speed [ ]
   - clarity [ ]
2. Transcription skills
   - vocabulary [ ]
   - spelling [ ]
   - letter placement [ ]
   - mailability [ ]
   - typing speed [ ]
   - figures [ ]
   - reference books [ ]

Telephone

1. Techniques [ ]
2. Incoming calls [ ]
3. Local outgoing calls [ ]
4. Long distance calls using DDD [ ]
5. Long distance calls using operator [ ]
6. Transferring calls [ ]
7. Directory [ ]
8. Courtesy [ ]
9. Speech [ ]
10. Efficiency [ ]
11. PBX switchboard [ ]
12. Multi-button switchboard [ ]
13. Special telephone services [ ]

Duplicating Processes

1. Fluid duplicating [ ]
2. Stencil duplicating [ ]
3. Offset duplicating [ ]
4. Copier [ ]

Office Machines

1. 10-key adding listing [ ]
2. Full keyboard [ ]
3. Electronic calculator [ ]
4. Rotary calculator [ ]
5. Collator [ ]
6. Folding machine [ ]

Travel & Transportation

1. Various travel services
   - domestic [ ]
   - international [ ]
2. Expense reports [ ]
3. Itineraries [ ]
4. Reservations [ ]
5. Travel funds [ ]

Telegraph

1. Correct service ☐
2. Word count
   - domestic ☐
   - international ☐
3. Systems ☐
4. Special services ☐
5. Various international services ☐

Filing Rules

1. Alphabetic filing
   - individual ☐
   - firm ☐
   - special ☐
2. Subject filing
   - subject division ☐
   - subject numeric ☐
3. Numeric filing
   - terminal-digit ☐
4. Geographic ☐
5. Chronological filing ☐

Filing Procedures

1. Routine ☐
2. Familiar with:
   - filing supplies ☐
   - equipment ☐
   - charge-out ☐
   - disposal of old files ☐
   - storage of data ☐
3. Systems ☐

Internal Communications

1. Set up written comm. ☐
2. Within a company ☐
3. Between branches ☐

Transcribing Machines

1. Operate ☐
2. Mailable copy ☐

Writing Business Letters

1. Compose business letters ☐
2. Complete form letters ☐

Payroll System

1. Basis of payment ☐
2. Records of time ☐
3. Figuring hours worked ☐
4. Figuring gross pay ☐
5. Deductions ☐
6. Computing net pay ☐
7. Employees earnings rcd. ☐
8. Payroll journal ☐
9. Disbursing payroll ☐

Work Experience

1. _____
2. _____
3. _____
4. _____
5. _____

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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Business Department

CONTOOCOOK VALLEY REGIONAL HIGH SCHOOL

ROUTE 202 NORTH

PETERBOROUGH, NEW HAMPSHIRE 03458

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: CLERICAL OFFICE PROCEDURES

YEAR OF GRADUATION _____ DATE TRANSMITTED: _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Introduction To Business Office

SELECTED INDIVIDUAL TASKS:

1. Acquainted with office world [ ]
2. Know opportunities available to clerical wkrs. [ ]
3. Know general qualifications required for office work [ ]
4. Recognize rewards & promotion possibilities in office work [ ]

Machine Computing Methods

1. Full-key adding listing [ ]
2. 10-key adding listing [ ]
3. Electronic calculator [ ]
4. Rotary calculator [ ]
5. Collator [ ]
6. Folding machine [ ]
7. Punched-tape machine [ ]
8. Punched-card machine [ ]
9. Magnetic & optical scanning machine [ ]

Basic Typewriting Procedures

1. Can operate efficiently:
   - IBM Selectric [ ]
   - IBM Standard [ ]
   - IBM Selectric II [ ]
   - IBM Executive [ ]
   - Adler Electric [ ]
2. Practices proper handling of all typewriters [ ]
3. Selects supplies [ ]

Letter Production Techniques

1. Letter parts [ ]
2. Proper margins [ ]
3. Punctuation forms [ ]
4. Letter styles [ ]
5. Envelopes [ ]
6. Erasures [ ]
7. Proofreading skills [ ]
8. Mailable letters from:
   - straight copy [ ]
   - rough draft [ ]
9. Stationery [ ]

Special Type Prod. Pbms.

1. Centering [ ]
2. Manuscripts, reports [ ]
3. Outlines [ ]
4. Footnotes [ ]
5. Bibliographies [ ]
6. Labels [ ]
7. Half-spacing [ ]
8. Fill-ins [ ]
9. Justify [ ]
10. Financial reports [ ]
11. Legal documents [ ]
12. Duplicating masters [ ]
13. Stencils [ ]
14. Offset masters [ ]
15. Copies needed [ ]
16. 4-page program using stylii [ ]

Telephone

1. Telephone technique [ ]
2. Incoming calls [ ]
3. Local outgoing calls [ ]
4. Long distance calls using DDD [ ]
5. Long distance calls using operator [ ]
6. Transferring calls [ ]
7. Directory [ ]
8. Courtesy [ ]
9. Speech [ ]
10. Efficiency [ ]
11. PBX switchboard [ ]
12. Multi-button switchboard [ ]
13. Special telephone services [ ]

Purchases

1. Budgeting [ ]
2. Requesting [ ]
3. Ordering [ ]
4. Receiving [ ]
5. Accounts payable [ ]

Internal Communications

1. Set up written comm. [ ]
2. Within a company [ ]
3. Between branches [ ]

Duplicating Processes

1. Fluid duplicating [ ]
2. Stencil duplicating [ ]
3. Offset machine [ ]
4. Copier [ ]

Transcribing Machines

1. Operate [ ]
2. Type mailable copy [ ]

Business Writing

1. Compose business ltrs. [ ]
2. Complete form letters [ ]

Sales

1. Contacting customers [ ]
2. Receiving orders [ ]
3. Billing [ ]
4. Accounts receivable [ ]

Filing Rules

1. Alphabetic filing
   - individual ☐
   - firm ☐
   - special ☐
2. Subject filing
   - subject division ☐
   - subject numeric ☐
3. Numeric filing
   - terminal-digit ☐
4. Geographic filing ☐
5. Chronological filing ☐

Filing Procedures

1. Filing routine ☐
2. Familiar with:
   - filing supplies ☐
   - filing equipment ☐
   - charge-out ☐
   - disposal of old files ☐
   - storage of data ☐
3. Filing systems ☐

Shipping Systems & Procedures

1. Preparation of goods ☐
2. Method of shipment ☐
3. Reference books ☐
4. Shipping papers ☐
5. Dispatching ☐
6. Other shipping functions ☐

Routine Cashiering Activities

1. Familiar with handling incoming funds
   - making change ☐
   - cash discount ☐
   - recording ☐
   - cashing checks ☐
2. Familiar with handling outgoing funds
   - authorization ☐
   - check writing ☐
   - recording ☐

Special Cashiering Activities

1. Refunds & allowances ☐
2. Credit cards ☐
3. Pricing charts ☐
4. Handling checks ☐
5. Petty cash ☐
6. Reconciling bank statement ☐

Telegraph

1. Correct service ☐
2. Word count
   - domestic ☐
   - international ☐
3. Systems ☐
4. Special services ☐
5. Various international services ☐

Mail Services

1. Classify mail ☐
2. Parcel specifications ☐
3. Special services ☐
4. Postage needed ☐
5. Incoming mail ☐
6. Outgoing mail ☐
7. ZIP codes ☐
8. Special service notations ☐
9. Bulk mail regulations ☐

Payroll Systems

1. Basis of payment ☐
2. Records of time ☐
3. Figuring hours worked ☐
4. Figuring gross pay ☐
5. Deductions ☐
6. Computing net pay ☐
7. Employees earnings rcd. ☐
8. Payroll journal ☐
9. Disbursing payroll ☐

Work Experience

1. _____
2. _____
3. _____
4. _____
5. _____

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as lateness	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
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SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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STUDENT'S NAME _____ PROGRAM: CLERICAL OFFICE PROCEDURES
YEAR OF GRADUATION _____ DATE TRANSMITTED: _____

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Machine Computing Methods

1. Full-key adding listing [ ]
2. 10-key adding listing [ ]
3. Electronic calculator [ ]
4. Rotary calculator [ ]
5. Collator [ ]
6. Folding machine [ ]
7. Punched-tape machine [ ]
8. Punched-card machine [ ]
9. Magnetic & optical scanning machine [ ]

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4. Letter styles [ ]
5. Envelopes [ ]
6. Erasures [ ]
7. Proofreading skills [ ]
8. Mailable letters from:
   - straight copy [ ]
   - rough draft [ ]
9. Stationery [ ]

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4. Footnotes [ ]
5. Bibliographies [ ]
6. Labels [ ]
7. Half-spacing [ ]
8. Fill-ins [ ]
9. Justify [ ]
10. Financial reports [ ]
11. Legal documents [ ]
12. Duplicating masters [ ]
13. Stencils [ ]
14. Offset masters [ ]
15. Copies needed [ ]
16. 4-page program using stylii [ ]

Telephone

1. Telephone technique [ ]
2. Incoming calls [ ]
3. Local outgoing calls [ ]
4. Long distance calls using DDD [ ]
5. Long distance calls using operator [ ]
6. Transferring calls [ ]
7. Directory [ ]
8. Courtesy [ ]
9. Speech [ ]
10. Efficiency [ ]
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13. Special telephone services [ ]

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3. Ordering [ ]
4. Receiving [ ]
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3. Between branches [ ]

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1. Compose business ltrs. [ ]
2. Complete form letters [ ]

Sales

1. Contacting customers [ ]
2. Receiving orders [ ]
3. Billing [ ]
4. Accounts receivable [ ]

Filing Rules

1. Alphabetic filing
   - individual ☐
   - firm ☐
   - special ☐
2. Subject filing
   - subject division ☐
   - subject numeric ☐
3. Numeric filing
   - terminal-digit ☐
4. Geographic filing ☐
5. Chronological filing ☐

Filing Procedures

1. Filing routine ☐
2. Familiar with:
   - filing supplies ☐
   - filing equipment ☐
   - charge-out ☐
   - disposal of old files ☐
   - storage of data ☐
3. Filing systems ☐

Shipping Systems & Procedures

1. Preparation of goods ☐
2. Method of shipment ☐
3. Reference books ☐
4. Shipping papers ☐
5. Dispatching ☐
6. Other shipping functions ☐

Routine Cashiering Activities

1. Familiar with handling incoming funds
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   - cash discount ☐
   - recording ☐
   - cashing checks ☐
2. Familiar with handling outgoing funds
   - authorization ☐
   - check writing ☐
   - recording ☐

Special Cashiering Activities

1. Refunds & allowances ☐
2. Credit cards ☐
3. Pricing charts ☐
4. Handling checks ☐
5. Petty cash ☐
6. Reconciling bank statement ☐

Telegraph

1. Correct service ☐
2. Word count
   - domestic ☐
   - international ☐
3. Systems ☐
4. Special services ☐
5. Various international services ☐

Mail Services

1. Classify mail ☐
2. Parcel specifications ☐
3. Special services ☐
4. Postage needed ☐
5. Incoming mail ☐
6. Outgoing mail ☐
7. ZIP codes ☐
8. Special service notations ☐
9. Bulk mail regulations ☐

Payroll Systems

1. Basis of payment ☐
2. Records of time ☐
3. Figuring hours worked ☐
4. Figuring gross pay ☐
5. Deductions ☐
6. Computing net pay ☐
7. Employees earnings rcd. ☐
8. Payroll journal ☐
9. Disbursing payroll ☐

Work Experience

1. _____
2. _____
3. _____
4. _____
5. _____

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
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FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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Business Department

CONTOOCOOK VALLEY REGIONAL HIGH SCHOOL

ROUTE 202 NORTH
PETERBOROUGH, NEW HAMPSHIRE 03458

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: ACCOUNTING I & II
YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Accounting Cycle

SELECTED INDIVIDUAL TASKS:

1. Starting accounting system:
   - Preparation of a balance sheet [ ]
2. Journalize entries using general journal [ ]
3. Post general journal entries [ ]
4. Preparation of:
   - 6-column work sheet [ ]
   - Income statement [ ]
   - Balance sheet [ ]
5. Closing the ledger [ ]

Use of Journals

Recording transactions in:

1. Combination journal [ ]
2. Purchases journal [ ]
3. Cash payments journal [ ]
4. General journal [ ]
5. 4-column general jrnl. [ ]
6. Sales journal [ ]
7. Cash receipts journal [ ]

End/Yr. Financial Statements

Merchandising business:

1. Preparation of:
   - 8-column work sheet [ ]
   - Income statement [ ]
   - Capital statement [ ]
   - Balance sheet [ ]
   - Recording adjusting entries [ ]
   - Recording closing entries [ ]

Partnerships

Recording of:

1. Formation of a partnership [ ]
2. Admission of a new partner [ ]
3. Liquidation of a partner [ ]
4. Methods of dividing income [ ]
5. End-of-year work:
   - Work sheets [ ]
   - Financial statements [ ]
   - Adjusting & closing entries [ ]
   - Post-closing trial balance [ ]
   - Reversing entries [ ]
   - Reporting of partner's federal income tax [ ]

Corporation

Transactions concerning:

1. Formation of corporation [ ]
2. Purchase of a business by a corporation [ ]
3. Sale of additional capital stock [ ]
4. Transfer of stock [ ]
5. Corporate bonds [ ]
6. Preparation of corporate financial reports:
   - Work sheet [ ]
   - Income statement [ ]
   - Capital statement [ ]
   - Balance sheet [ ]
   - Adjusting & closing entries [ ]
   - Post-closing trial balance [ ]
   - Reversing entries [ ]

Bad Debts

1. Establish allowance for bad debts account [ ]
2. Reporting of bad debts expense & allowance for bad debts on financial statements [ ]
3. Writing off uncollectible accounts
   - direct write-off method [ ]
   - allowance method [ ]
4. Recording of adjusting entries [ ]
5. Calculating accounts receivable turnover [ ]

Voucher System	Inventory	Budgetary Control System
1. Preparing vouchers ☐	1. Determining the quantity of merchandise inventory ☐	1. Designing budgets ☐
2. Recording in voucher register ☐	2. Pricing merchandise inventory ☐	2. Using past records to obtain data for budgeting ☐
3. Payment of vouchers ☐	3. Determining rate of turnover ☐	3. Planning income & expense budgets ☐
4. Using the check register ☐		4. Planning a cash budget ☐

Payroll	Data Processing In Acct.	Cash Register System
1. Preparation of payroll ☐	1. Comparison of manual, mechanical, & automatic processes in accounting ☐	1. Recording transactions ☐
2. Payment of payroll ☐	2. Preparing & reading punch cards ☐	2. Proving cash ☐
3. Recording payroll ☐	3. Preparation of flow chart of an accounting procedure ☐	3. Using subsidiary ledgers ☐
4. Reporting & paying payroll taxes & liabilities ☐		4. Establishing, proving, & replenishing petty cash fund ☐
5. Preparation of payroll tax reports ☐		

Depreciation	Notes	Special Problems In Acct.
1. Recording the purchases of fixed assets ☐	1. Recording notes receivable, notes payable, & interest on notes ☐	Recording of:
2. Determining amounts of depreciation expense ☐	2. Dishonoring notes receivable ☐	1. Installment sales ☐
3. Keeping of fixed asset records ☐	3. Discounting notes receivable ☐	2. Purchases of used merchandise accepted as trade-in ☐
4. Valuation of fixed assets ☐	4. Using notes receivable register ☐	3. Repossessed merchandise ☐
5. Adjustments for depreciation ☐	5. Issuing & payment of notes payable ☐	4. COD sales ☐
6. Disposing of fixed assets ☐	6. Recording of drafts ☐	5. Consignment transactions ☐
7. Recording the depletion of a fixed asset ☐	7. Recording of trade acceptances ☐	
8. Reporting of fixed assets & depreciation on financial statements ☐		

Taxes

Recording of entries involving:

- Sales taxes ☐
- Property taxes ☐

Income Recd. In Advance

Recording of:

1. Income received in advance as liabilities ☐
2. Income received in advance as income ☐
3. Accrued income ☐

Prepaid Expense/Accrued Expense

Recording of:

1. Prepaid expense as assets ☐
2. Prepaid expense as expense ☐
3. Accrued expenses ☐

Analysis Of Financial Statements

1. Preparation of comparative financial statements ☐
2. Analysis of financial statements ☐

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record Is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
FLEXIBILITY & ADAPTABILITY: Consider the speed with which he learns and the amount of instruction required to teach him new duties	Learns Fast ☐	Learns Reasonably Fast ☐	Slow to Learn ☐	Unable to Learn ☐
SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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CONVAL HIGH SCHOOL
BUSINESS DEPARTMENT

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: ACCOUNTING I & II
YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Accounting Cycle

SELECTED INDIVIDUAL TASKS:

1. Starting accounting system:
   - Preparation of a balance sheet [ ]
2. Journalize entries using general journal [ ]
3. Post general journal entries [ ]
4. Preparation of:
   - 6-column work sheet [ ]
   - Income statement [ ]
   - Balance sheet [ ]
   - Closing the ledger [ ]

Use of Journals

Recording transactions in:

1. Combination journal [ ]
2. Purchases journal [ ]
3. Cash payments journal [ ]
4. General journal [ ]
5. 4-column general jrnl. [ ]
6. Sales journal [ ]
7. Cash receipts journal [ ]

End/Yr. Financial Statements

Merchandising business:

1. Preparation of:
   - 8-column work sheet [ ]
   - Income statement [ ]
   - Capital statement [ ]
   - Balance sheet [ ]
   - Recording adjusting entries [ ]
   - Recording closing entries [ ]

Partnerships

Recording of:

1. Formation of a partnership [ ]
2. Admission of a new partner [ ]
3. Liquidation of a partner [ ]
4. Methods of dividing income [ ]
5. End-of-year work:
   - Work sheets [ ]
   - Financial statements [ ]
   - Adjusting & closing entries [ ]
   - Post-closing trial balance [ ]
   - Reversing entries [ ]
   - Reporting of partner's federal income tax [ ]

Corporation

Transactions concerning:

1. Formation of corporation [ ]
2. Purchase of a business by a corporation [ ]
3. Sale of additional capital stock [ ]
4. Transfer of stock [ ]
5. Corporate bonds [ ]
6. Preparation of corporate financial reports:
   - Work sheet [ ]
   - Income statement [ ]
   - Capital statement [ ]
   - Balance sheet [ ]
   - Adjusting & closing entries [ ]
   - Post-closing trial balance [ ]
   - Reversing entries [ ]

Bad Debts

1. Establish allowance for bad debts account [ ]
2. Reporting of bad debts expense & allowance for bad debts on financial statements [ ]
3. Writing off uncollectible accounts
   - direct write-off method [ ]
   - allowance method [ ]
4. Recording of adjusting entries [ ]
5. Calculating accounts receivable turnover [ ]

Voucher System	Inventory	Budgetary Control System
1. Preparing vouchers ☐	1. Determining the quantity of merchandise inventory ☐	1. Designing budgets ☐
2. Recording in voucher register ☐	2. Pricing merchandise inventory ☐	2. Using past records to obtain data for budgeting ☐
3. Payment of vouchers ☐	3. Determining rate of turnover ☐	3. Planning income & expense budgets ☐
4. Using the check register ☐		4. Planning a cash budget ☐

Payroll	Data Processing In Acct.	Cash Register System
1. Preparation of payroll ☐	1. Comparison of manual, mechanical, & automatic processes in accounting ☐	1. Recording transactions ☐
2. Payment of payroll ☐	2. Preparing & reading punch cards ☐	2. Proving cash ☐
3. Recording payroll ☐	3. Preparation of flow chart of an accounting procedure ☐	3. Using subsidiary ledgers ☐
4. Reporting & paying payroll taxes & liabilities ☐		4. Establishing, proving, & replenishing petty cash fund ☐
5. Preparation of payroll tax reports ☐		

Depreciation	Notes	Special Problems In Acct.
1. Recording the purchases of fixed assets ☐	1. Recording notes receivable, notes payable, & interest on notes ☐	Recording of:
2. Determining amounts of depreciation expense ☐	2. Dishonoring notes receivable ☐	1. Installment sales ☐
3. Keeping of fixed asset records ☐	3. Discounting notes receivable ☐	2. Purchases of used merchandise accepted as trade-in ☐
4. Valuation of fixed assets ☐	4. Using notes receivable register ☐	3. Repossessed merchandise ☐
5. Adjustments for depreciation ☐	5. Issuing & payment of notes payable ☐	4. COD sales ☐
6. Disposing of fixed assets ☐	6. Recording of drafts ☐	5. Consignment transactions ☐
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BUSINESS DEPARTMENT

77/78

CONTOOCOOK VALLEY REGIONAL HIGH SCHOOL

ROUTE 202 NORTH
PETERBOROUGH, NEW HAMPSHIRE 03458

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ VOCATIONAL PROGRAM: MACHINE TOOL
YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Safety

SELECTED INDIVIDUAL TASKS:

1. Shop regulations
2. General housekeeping
3. OSHA regulations
4. Clothing
5. Eye protection
6. Fire hazards & equip.

Crib (Tool)

1. Sockets
2. Open end wrenches
3. Box end wrenches
4. Combination wrenches
5. Torque wrenches
6. Allen wrenches
7. Screwdrivers
8. Issue tools
9. Check condition of returned tools
10. Use inventory cards

Inspection/Measurement

1. Micrometer
2. Vernier caliper
3. Depth mike
4. Indicators
5. Gauge blocks
6. Sine bar setups
7. Telescoping gauge
8. Vernier height gauge
9. Surface plate
10. Calipers
11. Protractor
12. Thread pitch gauge

Specification Sheets

1. Sketching
2. Sectional prints
3. Orthographic prints
4. Procedure sheets
5. Abbreviations
6. Tolerances

Bench & Floor Work

1. Filing
2. Drawfile
3. Chisel work
4. Hand hacksaw
5. Power hacksaw
6. Tapping & die
7. Hand ream
8. Assemble
9. Bench polish
10. File test

Drill Press

1. Speeds
2. Center drill
3. Drilling
4. Drill pointing
5. Reaming
6. Countersink
7. Counterbore
8. Lapping
9. V block
10. Jigs

Vertical Miller

1. Speeds
2. Drill
3. Bore
4. Fly cutter
5. End mill
6. Index
7. Inspection
8. Layout
9. V block
10. Step blocks
11. Dial indicator
12. Collets
13. Safety
14. Jigs
15. Square A block

Heat Treat

1. Operate:
   - Heat treat furnace
   - Tempering ovens
   - Quenching equipment
2. Regulate temperatures
3. Control heating cycles
4. SAE identification

Band Saw

1. Speeds
2. Blade types

Grinding

1. Surface/Cylindrical
   - Safety ☐
   - Dress & adjust grinding wheels ☐
   - Speeds and feeds ☐
   - Flat & parallel ☐
   - Shoulder on angle iron ☐
   - Forms ☐
   - Arbors & vices ☐
   - Jigs ☐
   - Cutter grinding ☐
   - Lubrication ☐
2. Pedestal
   - Safety ☐
   - Dress & adjust grinding wheel ☐
   - Wheel selection ☐
   - Dressing ☐
   - Drill sharpening ☐
   - Metal identification ☐
   - Lathe tool grinding ☐
   - Snagging ☐

Lathe

1. Safety ☐
2. Center drill ☐
3. Spot drill ☐
4. Facing ☐
5. R. turn ☐
6. Finish turn ☐
7. Square shoulder ☐
8. Knurling ☐
9. Cutting speeds ☐
10. Feed speeds ☐
11. Lubrication ☐
12. Tool bits
    - Facing ☐
    - Turning ☐
    - Cutting ☐
    - Necking ☐
    - Forming ☐
    - Threading ☐
13. Collets ☐
14. Drilling ☐
15. Reaming ☐
16. Filing ☐
17. Polishing ☐
18. Bore straight hole ☐
19. Bore tapered hole ☐
20. Taper turn
    - Compound ☐
    - Tail stock ☐
    - Taper attachment ☐
21. Faceplate work ☐
22. Form turning ☐
23. Chuck work
    - 1-3 jaw universal ☐
    - 2-4 jaw universal ☐

Co-op Work Experience

1. _____ Level I
2. _____ " I
3. _____ " I
4. _____ " I
5. _____ Level I
6. _____ " II
7. _____ " II
8. _____ " II
9. _____ Level III
10. _____ " III

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SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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BUSINESS DEPARTMENT

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YEAR OF GRADUATION _____ DATE TRANSMITTED _____

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   - Wheel selection ☐
   - Dressing ☐
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Conant High School

109 STRATTON ROAD
JAFFREY, NEW HAMPSHIRE 03452
Telephone: 532-7756

Area Vocational
Center #14

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: GRAPHIC ARTS (Offset)
YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
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Cold Type Composition

SELECTED INDIVIDUAL TASKS:

1. Recognition of:
   - 4 major type faces [ ]
   - good camera copy [ ]
2. On Varityper, understand & be able to:
   - Set up [ ]
   - Insert fonts [ ]
   - Operation of [ ]
   - Change ribbons [ ]
   - Justification of copy [ ]
3. For Headliner, understand & be able to:
   - Set up [ ]
   - Mix chemicals for [ ]
   - Fill developing tank [ ]
   - Make ready a font [ ]
   - Change fonts [ ]
   - Set posi. & neg. on [ ]
4. Using Chartpak products, Paste-on & rub-on [ ]
5. Use & eval. of prev. ptd. mat. for copy/line & hftn [ ]

Darkroom Procedures--Wet & Dry

1. Identification of film [ ]
2. Base vs. emulsion sides [ ]
3. Types of film, ortho, pan [ ]
4. Screen iden. and use [ ]
5. Filter iden. and use [ ]
6. Storage & care of film [ ]
7. Construction of film [ ]
8. Neg. vs. Pos. and use [ ]
9. Camera setup for line work [ ]
10. Focusing w/ground glass [ ]
11. Enlarging and reducing [ ]
12. Positioning of lights [ ]
13. Vacuum back operation [ ]
14. Spg.loaded cpyhldr oper. [ ]
15. Lens adjustment & why [ ]
16. Timing of exposure [ ]
17. Proper exposure for line [ ]
18. Proper exp. for halftone [ ]
19. Use of proportional scale [ ]
20. Stor. of neg. & positives [ ]
21. Use of linen tester or magnifier [ ]
22. Combination exposures [ ]

Wet Side of Darkroom Operation

1. Bring temp. control sink to operation [ ]
2. Care of sink [ ]
3. Storage of materials, chemicals, etc. [ ]
4. Measuring of chemicals [ ]
5. Exp. of "A" & "B" dev. [ ]
6. Hypo & its use & life [ ]
7. 4-tray pro. of devel. [ ]
8. Wash neg. & positives [ ]
9. Proper dev. tech. for out-of-the-ordinary situations/poor copy [ ]
10. Safe lighting tech. [ ]
11. Proper cleanup proced. [ ]
12. Safety proced. for all darkroom work [ ]
13. Proper drying of film after exposure [ ]
14. Proper handling of exposed film [ ]

Platemaking

1. Different types plates [ ]
2. Prop. hand. of plates, before, after & duc.exp [ ]
3. Operation of platemaker [ ]
4. Changing of carbon arcs [ ]
5. Proper exp. time, etc. [ ]
6. Care of platemaker [ ]
7. Safety precautions/ptemk [ ]
8. Proper devl. of plates [ ]
9. Use & stor. of chemicals [ ]
10. Prop. washing plates w/ prop. mat. to prevent dmg [ ]
11. Prop. meth. of plate coating for storage [ ]

Inks & Their Uses

1. Regular [ ]
2. Fast drying [ ]
3. Black vs. colors [ ]
4. Transparent vs. opaque [ ]
5. Toners [ ]
6. Varnishes & their uses [ ]
7. Driers, types & uses [ ]
8. Crystallization causes and cures [ ]
9. Offseting & preventions [ ]

Safety

1. Safety measures for entire shop [ ]

Stripping Techniques

1. Introduction of tools employed ☐
2. Use of light table ☐
3. Use of "T" square & triangles ☐
4. Proper measuring techniques ☐
5. Proper positioning of "mask" on table ☐
6. Identification of proper masking material ☐
7. Use of various types of tapes ☐
8. Use of various types of marking devices ☐
9. Use of various cutting tools, razor blades, X-acto knives, etc. ☐
10. Scribing with various instruments ☐
11. Window construction on masks for double exp. ☐
12. Proper handling of masks during use & for stor. ☐
13. Proper opaquing techniques ☐
14. Proper opaquing materials, etc. ☐

Bindery Skills

1. Stock handling ☐
2. Fanning & counting stock ☐
3. Recognition of various kinds of stock ☐
4. Proper packing procedures ☐
5. Proper unpacking proced. ☐
6. Operation of automatic cutter ☐
7. Safety around cutter ☐
8. Changing blades or knives for cutter ☐
9. Care of cutting knives ☐
10. Storage of cutting knives ☐
11. Trimming of booklets ☐
12. Figuring stock, etc. ☐
13. Padding, collating of paper ☐
14. Stitching booklets & flat stock ☐
15. Care of stitcher & wire changing ☐
16. Paper drilling & care of machine ☐
17. Changing drills ☐
18. Round cornering & slitting ☐
19. Folding, single & multiple ☐
20. Scoring & perforating on folder ☐
21. Care of folder ☐

Offset Press Operation & Care

1. Machine features ☐
2. Feeder & register board ☐
3. Adjustment of feeder ☐
4. Adjustment of register board ☐
5. Machine controls ☐
6. Inking unit operation and care ☐
7. Replex system, care & operation ☐
8. Ink unit ☐
9. Care & operation of ink unit ☐
10. Delivery unit ☐
11. Adjustment of delivery unit ☐
12. Registering problems & solutions ☐
13. Printing unit ☐
14. Plate handling on unit ☐
15. Three cylinder knowledge ☐
16. Process principle ☐
17. Plate cylinder, impression cylinder & blanket cylinder ☐
18. Blanket care ☐
19. Blanket affixing & removal ☐
20. Problems & probable causes & solutions ☐

WORK HABITS

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SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: GRAPHIC ARTS (Offset)
YEAR OF GRADUATION _____ DATE TRANSMITTED _____

LEVEL OF PROFICIENCY:

- [ ] Student acquainted with job--limited skill
- [ ] Student can perform job under close supervision
- [ ] Student can perform job with minimum supervision
- [ ] Student has job-entry performance skills

Cold Type Composition

SELECTED INDIVIDUAL TASKS:

1. Recognition of:
   - 4 major type faces [ ]
   - good camera copy [ ]
2. On Varityper, understand & be able to:
   - Set up [ ]
   - Insert fonts [ ]
   - Operation of [ ]
   - Change ribbons [ ]
   - Justification of copy [ ]
3. For Headliner, understand & be able to:
   - Set up [ ]
   - Mix chemicals for [ ]
   - Fill developing tank [ ]
   - Make ready a font [ ]
   - Change fonts [ ]
   - Set posi. & neg. on [ ]
4. Using Chartpak products, Paste-on & rub-on [ ]
5. Use & eval. of prev. ptd. mat. for copy/line & hftn [ ]

Darkroom Procedures--Wet & Dry

1. Identification of film [ ]
2. Base vs. emulsion sides [ ]
3. Types of film, ortho, pan [ ]
4. Screen iden. and use [ ]
5. Filter iden. and use [ ]
6. Storage & care of film [ ]
7. Construction of film [ ]
8. Neg. vs. Pos. and use [ ]
9. Camera setup for line work [ ]
10. Focusing w/ground glass [ ]
11. Enlarging and reducing [ ]
12. Positioning of lights [ ]
13. Vacuum back operation [ ]
14. Spg.loaded cpyhldr oper. [ ]
15. Lens adjustment & why [ ]
16. Timing of exposure [ ]
17. Proper exposure for line [ ]
18. Proper exp. for halftone [ ]
19. Use of proportional scale [ ]
20. Stor. of neg. & positives [ ]
21. Use of linen tester or magnifier [ ]
22. Combination exposures [ ]

Wet Side of Darkroom Operation

1. Bring temp. control sink to operation [ ]
2. Care of sink [ ]
3. Storage of materials, chemicals, etc. [ ]
4. Measuring of chemicals [ ]
5. Exp. of "A" & "B" dev. [ ]
6. Hypo & its use & life [ ]
7. 4-tray pro. of devel. [ ]
8. Wash neg. & positives [ ]
9. Proper dev. tech. for out-of-the-ordinary situations/poor copy [ ]
10. Safe lighting tech. [ ]
11. Proper cleanup proced. [ ]
12. Safety proced. for all darkroom work [ ]
13. Proper drying of film after exposure [ ]
14. Proper handling of exposed film [ ]

Platemaking

1. Different types plates [ ]
2. Prop. hand. of plates, before, after & duc.exp [ ]
3. Operation of platemaker [ ]
4. Changing of carbon arcs [ ]
5. Proper exp. time, etc. [ ]
6. Care of platemaker [ ]
7. Safety precautions/ptemk [ ]
8. Proper devl. of plates [ ]
9. Use & stor. of chemicals [ ]
10. Prop. washing plates w/ prop. mat. to prevent dmg [ ]
11. Prop. meth. of plate coating for storage [ ]

Inks & Their Uses

1. Regular [ ]
2. Fast drying [ ]
3. Black vs. colors [ ]
4. Transparent vs. opaque [ ]
5. Toners [ ]
6. Varnishes & their uses [ ]
7. Driers, types & uses [ ]
8. Crystalization causes and cures [ ]
9. Offseting & preventions [ ]

Safety

1. Safety measures for entire shop [ ]

Stripping Techniques

1. Introduction of tools employed ☐
2. Use of light table ☐
3. Use of "T" square & triangles ☐
4. Proper measuring techniques ☐
5. Proper positioning of "mask" on table ☐
6. Identification of proper masking material ☐
7. Use of various types of tapes ☐
8. Use of various types of marking devices ☐
9. Use of various cutting tools, razor blades, X-acto knives, etc. ☐
10. Scribing with various instruments ☐
11. Window construction on masks for double exp. ☐
12. Proper handling of masks during use & for stor. ☐
13. Proper opaquing techniques ☐
14. Proper opaquing materials, etc. ☐

Bindery Skills

1. Stock handling ☐
2. Fanning & counting stock ☐
3. Recognition of various kinds of stock ☐
4. Proper packing procedures ☐
5. Proper unpacking proced. ☐
6. Operation of automatic cutter ☐
7. Safety around cutter ☐
8. Changing blades or knives for cutter ☐
9. Care of cutting knives ☐
10. Storage of cutting knives ☐
11. Trimming of booklets ☐
12. Figuring stock, etc. ☐
13. Padding, collating of paper ☐
14. Stitching booklets & flat stock ☐
15. Care of stitcher & wire changing ☐
16. Paper drilling & care of machine ☐
17. Changing drills ☐
18. Round cornering & slitting ☐
19. Folding, single & multiple ☐
20. Scoring & perforating on folder ☐
21. Care of folder ☐

Offset Press Operation & Care

1. Machine features ☐
2. Feeder & register board ☐
3. Adjustment of feeder ☐
4. Adjustment of register board ☐
5. Machine controls ☐
6. Inking unit operation and care ☐
7. Replex system, care & operation ☐
8. Ink unit ☐
9. Care & operation of ink unit ☐
10. Delivery unit ☐
11. Adjustment of delivery unit ☐
12. Registering problems & solutions ☐
13. Printing unit ☐
14. Plate handling on unit ☐
15. Three cylinder knowledge ☐
16. Process principle ☐
17. Plate cylinder, impression cylinder & blanket cylinder ☐
18. Blanket care ☐
19. Blanket affixing & removal ☐
20. Problems & probable causes & solutions ☐

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
RELIABILITY: Consider the ability of the person to get the work out under pressure, and to follow job through to completion	Can always be counted upon ☐	Generally can be counted on ☐	Unpredictable ☐	Seldom reliable under pressure ☐
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SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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CONVAL HIGH SCHOOL
BUSINESS DEPARTMENT

Conant High School

109 STRATTON ROAD
JAFFREY, NEW HAMPSHIRE 03452
Telephone: 532-7756

Area Vocational Center #14

PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: HORTICULTURE
YEAR OF GRADUATION _____ DATE TRANSMITTED: _____

LEVEL OF PROFICIENCY:

- [x] Student acquainted with job--limited skill
- [x] Student can perform job under close supervision
- [x] Student can perform job with minimum supervision
- [x] Student has job-entry performance skills

Greenhouse Management

SELECTED INDIVIDUAL TASKS:

1. Start seedlings ☐
2. Transplant seedlings ☐
3. Start cuttings ☐
4. Transplant cuttings ☐
5. Fertilize with:
   - solid fertilizers ☐
   - liquid fertilizers
     - hozon method ☐
     - proportioner method ☐
6. Mix soil ☐
7. Sterilize soil:
   - steam ☐
   - electrically ☐
   - chemically ☐
8. Pesticides:
   - aerosol ☐
   - spray ☐
   - dust ☐
   - drench ☐
9. Harvesting & shipping cut flowers ☐

Landscape Design/Maintenance

1. Landscape symbols ☐
2. Design principles ☐
3. Use of structures ☐
4. Theme ☐
5. Color and lighting ☐
6. Development of landscape areas
   - public ☐
   - private ☐
   - service & recreation ☐
7. Grading ☐
8. Conditioning soil ☐
9. Supplying drainage ☐
10. Construction of:
    - walks & driveways ☐
    - patios & terraces ☐
    - fences & walls ☐
11. Establishment of lawn for:
    - shady areas ☐
    - semi-shade ☐
    - sunny ☐
    - recreational ☐
    - steep slope ☐
12. Planting trees
    - bare rooted ☐
    - balled & burlapped ☐
13. Protecting trees
    - wrapping ☐
    - staking ☐
14. Planting shrubs ☐
15. Planting flowers
    - annuals ☐
    - biennials ☐
    - perennials ☐
16. Fertilizing
    - lawns ☐
    - trees ☐
    - shrubs ☐
    - flowers ☐

Floral Design & Arrangement

1. How to cut flowers ☐
2. When to cut flowers ☐
3. Charring ☐
4. Hammering ☐
5. Stripping ☐
6. Stemming ☐
7. Design principles
   - containers ☐
   - balance ☐
   - use of greens ☐
   - constructing corsages ☐
   - floral pieces ☐
   - specialty arrangements ☐
   - dried flowers ☐
   - correct use of preservatives ☐

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WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as latenesses	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
ATTITUDE: Consider his attitude toward his work, company & associates, and his willingness to work with and for others	Unusually Fine Attitude ☐	Good Attitude ☐	Passable ☐	Poor Attitude ☐
JUDGMENT & INITIATIVE: Consider his ability to make decisions and to utilize working time to best advantage	Justifies Utmost Confidence ☐	Applies Himself Well ☐	Needs Frequent Checking ☐	Cannot be relied upon; Needs constant supervision ☐
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SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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PERFORMANCE SKILLS PROFILE

STUDENT'S NAME _____ PROGRAM: HORTICULTURE
YEAR OF GRADUATION _____ DATE TRANSMITTED: _____

LEVEL OF PROFICIENCY:

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Greenhouse Management

SELECTED INDIVIDUAL TASKS:

1. Start seedlings ☐
2. Transplant seedlings ☐
3. Start cuttings ☐
4. Transplant cuttings ☐
5. Fertilize with:
   - solid fertilizers ☐
   - liquid fertilizers
     - hozon method ☐
     - proportioner method ☐
6. Mix soil ☐
7. Sterilize soil:
   - steam ☐
   - electrically ☐
   - chemically ☐
8. Pesticides:
   - aerosol ☐
   - spray ☐
   - dust ☐
   - drench ☐
9. Harvesting & shipping cut flowers ☐

Landscape Design/Maintenance

1. Landscape symbols ☐
2. Design principles ☐
3. Use of structures ☐
4. Theme ☐
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6. Development of landscape areas
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    - shady areas ☐
    - semi-shade ☐
    - sunny ☐
    - recreational ☐
    - steep slope ☐
12. Planting trees
    - bare rooted ☐
    - balled & burlapped ☐
13. Protecting trees
    - wrapping ☐
    - staking ☐
14. Planting shrubs ☐
15. Planting flowers
    - annuals ☐
    - biennials ☐
    - perennials ☐
16. Fertilizing
    - lawns ☐
    - trees ☐
    - shrubs ☐
    - flowers ☐

Floral Design & Arrangement

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2. When to cut flowers ☐
3. Charring ☐
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5. Stripping ☐
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7. Design principles
   - containers ☐
   - balance ☐
   - use of greens ☐
   - constructing corsages ☐
   - floral pieces ☐
   - specialty arrangements ☐
   - dried flowers ☐
   - correct use of preservatives ☐

WORK HABITS

ATTENDANCE & PUNCTUALITY: Consider frequency of absences as well as lateness	Record is Excellent ☐	Occasionally Absent/Late ☐	Frequently Absent/Late ☐	Undependable: Absent/Late Without Notice ☐
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SAFETY CONSCIOUSNESS: Consider appearance, "housekeeping," conform to work standards	Decidedly Favorable ☐	Good ☐	Passable ☐	Generally Unsatisfactory ☐

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Business Department

PROCESS FOR REPORTING STUDENT PROGRESS

ON THE

PERFORMANCE SKILLS PROFILES

GUIDANCE DEPARTMENT WILL:

1. Upon a student's entry into a vocational program (including 2nd-year courses), the instructor will be given a Performance Skill Profile, including student's name, and anticipated year of graduation. This profile includes selected individual tasks representative of the two-year vocational program.

2. At the end of each school year, the guidance department will file the Student Performance Skill Profile in the student's cumulative record.

   Area Vocational Students. Profiles on area vocational students will remain at Con-Val. When the student has completed the vocational program, a copy of the profile will go to the sending school to become part of the student's permanent record.

3. When a student completes the vocational program, the Performance Skill Profile will become part of his permanent record.

4. If a vocational student requests a copy of his Performance Skill Profile to assist him in securing full time, part time, or summer employment, the guidance department will obtain the profile from the vocational teacher and provide necessary copies.

5. Upon request, the guidance department will provide, with student permission, prospective employers with copies of the Student Performance Skill Profile.

6. If a vocational student is seeking admission to a post-secondary school, the guidance department will provide a copy of the Student Performance Skill Profile as part of the educational placement process.

TEACHER WILL:

1. At the end of each marking quarter, the teacher will indicate the student's level of proficiency on each of the selected individual tasks listed. If the student has not been exposed to a unit or particular task, no mark should be recorded.

2. Throughout the school year, the instructor will keep on file the Student Performance Skill Profile for students in his program.

3. At the end of each school year, the instructor will return all Student Performance Skill Profiles to the guidance department.

   Profiles on students completing the two-year sequence should be thoroughly reviewed and updated as they will become part of the student's permanent record.

SUGGESTED USES

FOR THE

STUDENT PERFORMANCE SKILLS PROFILES

1. Provides school with a reporting system for vocational programs which supplements the present grading system.

2. Teachers can send copies of profiles to parents on a quarter-year basis, so parents can "trace" student progress on selected individual tasks.

3. Teachers can readily review individual profile with the student allowing the student to know "where he stands" at any given point in time.

4. Assist school personnel and student in the job placement process.

5. Provides specific information for prospective employers of vocational students in selection process.

6. Provides specific information for employers in the supervision of newly hired "vocational students."

7. Provides a vocational program description which assist school personnel and students in course selection. (Particularly helpful for area vocational centers.)

8. Provides schools with a public relations instrument for accountability.

9. Provides schools with a public relations instrument for information relating to vocational programs.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Statement of the Problem, Purposes and Objectives --

From the first year of the vocational program at Contoocook Valley Regional High School, a behavioral objectives format has been followed. Course outlines are clearly written and continue to be revised. Although the content of the offerings has been well defined, the grading system continues to be a rather traditional format of As, Bs, Cs, etc. A more concise and efficient method of reporting student progress and skills level needs to be developed and implemented.

The purpose of the project can be summarized by stating the objectives listed in chapter 1.

The vocational guidance counselor assisted by the vocational staff, will develop criterion referenced profiles for each vocational program being taught at Contoocook Valley Regional High School.

1. Building Construction
2. Vocational Drafting
3. Electronics
4. Residential Wiring
5. Health Occupations
6. Food Service
7. Secretarial Office Procedures
8. Clerical Office Procedures
9. Accounting
10. Machine Tool Processes
11. Graphic Arts
12. Horticulture

Profiles from each of the 12 programs include selected individual tasks which hi-light a student's ability in the vocational program pursued and work habit comments such as attendance, flexibility and safety consciousness.

The vocational guidance counselor will develop the data collection process whereby information will be recorded on students performance skills profiles.

The vocational guidance counselor will design and have constructed a descriptive flyer of vocational education at Contoocook Valley Regional High School.

Method of Investigation --An initial step taken in this project was contacting several vocational high schools throughout Massachusetts, requesting information on performance type reports. Only one school responded with the information requested.

Meetings were held with personnel people at N.H. Ball Bearing to obtain feedback regarding the project. It was suggested that the school publisize the vocational programs as a first step in the placement process.

A descriptive flyer on vocational education in area vocational center (#14) was developed. Area vocational center (#14) encompasses the schools of Mascenic Regional (New Ipswich), Conant High School (Jaffrey), Wilton-Lyneboro (Wilton), and Contoocook Valley Regional High School (Peterborough).

The next step of the project was the development of the Student Performance Skills Profiles. Basically, selected individual tasks,

depicting what is covered in each of several units covered by the vocational course, were written by the vocational teacher. Conferences involving the teacher, vocational guidance counselor, vocational director and community personnel took place to shape the final product. As each profile took shape, camera ready copy was typed and the profile was printed at Contoocook Valley Regional High School.

The third component of the project is developing the system for reporting progress. Several meetings involving vocational guidance counselor, vocational director and teachers took place. Out of these meetings came a workable system which was field tested using the health occupations profile.

Final rewrite of the process of reporting grades was taken and this form was printed at Contoocook Valley Regional High School.

In addition, a suggested uses of the Student Performance Skills Profile form was written, reviewed and printed at Contoocook Valley Regional High School.

Recommendations -- Dissemination of the profiles is the responsibility of the State Department of Education. 200 copies of each profile is made available to the State Department of Education for this purpose.

It is suggested that each school offering a similar vocational education program, review the profile in light of the course outline, modify these profiles to fit their objectives, and incorporate this reporting system as a supplement to the present method of letter grades.

ACCESSION NUMBER: VT102526

PUBLICATION DATE: 20JUN75

TITLE: "CAREER DAYS" EXEMPLARY PROJECT. FINAL REPORT.

PERSONAL AUTHOR: WATKINS, PHILIP A.

DESCRIPTOR: DEVELOPMENTAL PROGRAMS; *CAREER EDUCATION; INSERVICE TEACHER EDUCATION; *FIELD TRIPS; *WORK EXPERIENCE PROGRAMS; SENIOR HIGH SCHOOLS; *GRADE 11; *GRADE 10

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 25P.

ABSTRACT: COVERING THE PERIOD OF SEPTEMBER 1974 TO JUNE 1975, THIS REPORT DESCRIBES THE ACTIVITIES OF AN EXEMPLARY PROJECT IN CAREER EDUCATION FOR HALL-DALE HIGH SCHOOL STUDENTS. THE MAIN FEATURES OF THE PROGRAM INCLUDED A THREE-DAY CAREER DAYS PROGRAM FOR ELEVENTH GRADE STUDENTS, EIGHT MINITRIPS FOR SOPHOMORE STUDENTS, AND INSERVICE PROGRAMS FOR FACULTY. DURING THE CAREER DAYS PROGRAM, EACH STUDENT HAD THE OPPORTUNITY TO TRY THREE DIFFERENT JOBS FOR ONE DAY. THE RESULTS OF THE PROGRAM AS EVALUATED BY THE STUDENTS ARE INCLUDED IN THE REPORT. ALSO INCLUDED ARE BRIEF DESCRIPTIONS OF EACH FIELD TRIP, AND A REPORT ON THE INSERVICE PROGRAM CONDUCTED FOR THE FACULTY. (AUTHOR/NJ)

INSTITUTION NAME: HALL-DALE HIGH SCHOOL, HALLOWELL, MAINE.

SPONSORING AGENCY NAME: MAINE STATE DEPT. OF EDUCATIONAL AND CULTURAL SERVICES, AUGUSTA. BUREAU OF VOCATIONAL EDUCATION.; OFFICE OF EDUCATION (DHEW), WASHINGTON, D.C.

102 526

FINAL REPORT

"CAREER DAYS" EXEMPLARY PROJECT

Conducted Under
Part C or Part D of Public Law 90-576

Philip A. Watkins
S. A. D. #16 Hall-Dale High School
Hallowell, Maine

VT 102 526

2

20-June-75

Final REPORT(Type of Report)

Exemplary Project

Conducted Under
Part C and Part D of Public Law 90-576

The project reported herein was performed pursuant to a grant from the Bureau of Vocational Education, Maine Department of Educational and Cultural Services. Grantees undertaking such projects under State department sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions do not, therefore, necessarily represent official Department of Educational & Cultural Services position or policy.

Philip A. Watkins
S. A. D. #16 Hall-Dale High School
Hallowell, Maine 04347

20-June-75

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1. Summary of Report

2. Body of Report - Conclusions & Recommendations

3. Appendixes

SUMMARY:

(a. Time Period for reporting was 1-September-74 to 20-June-75

(b) The objectives of the Project included:

1) a three day "Career Days" experience for junior students

2) Thirty-six (36) mini-trips for sophomore students accompanied by faculty

3) sensitizing faculty to Career Education through the use of consultants

4) release time for three selected faculty members to study Career Education delivery systems for one week and make a final report

(c) Procedure followed:

1) a three day Career Days Program was successfully conducted for junior students (see Appendix 1)

2) eight (8) mini-trips were conducted for sophomore students (see Appendix 2)

3) consultants from the Career Education Office at South Portland High School conducted a program for all the Faculty at Hall-Dale

4) three faculty members were released for one week to study Career Education delivery systems (see Appendix 3)

(d) Results and Accomplishments:

see Appendixes 1, 2, and 3

(e) Evaluation:

see Appendixes 1, 2, and 3

(f) Conclusions:

see Appendixes 1, 2, and 3

BODY OF THE REPORT:

Conclusions and Recommendations

a. both the sophomore Mini-trip Program and the junior Career Days Program were highly successful from a student perspective. (See Appendix 1 and 2)

b. only eight(8) mini-trips for sophomores were accomplished, however, due to lack of faculty initiative and enthusiasm.

c. some faculty were highly motivated by the consultants from South Portland High School and are implementing Career Education Programs within their curriculum. (Of a total of twenty-four (24) faculty members nine (9) are attempting to implement Career Education Programs within their classroom activities.)

d. the three (3) faculty members released for one week to study Career Education Delivery Systems concluded that a Career Information Center and full-time Guidance Librarian/Secretary are of paramount importance at Hall-Dale High School for the operation of an efficient and effective Guidance/Career Education Program. The above recommendations were forwarded to the Superintendent of Schools and Members of the Board through the high school Principal along with recommendations for staff and space allocations. (See Appendix 3). All recommendations were rejected by the Superintendent due to financial and other factors.

e. it is therefore concluded that all of the above programs be implemented and expanded as financial and other political factors permit.

APPENDIX #1

REPORT TO THE ADMINISTRATION

ON

"CAREER DAYS" WORK EXPERIENCE PROGRAM 1975

Philip A. Watkins
Director of Counseling
Hall-Dale High School
Hallowell, Maine

INTRODUCTION:

On May 13th, 14th, and 15th, 1975, seventy-one Junior students at Hall-Dale High School participated in a "Career Days" hands-on experience in the world of work. During the "Career Days" Program, each student was given the opportunity to try three different jobs of his choice for one day. At the completion of the Program all participants were given the opportunity to evaluate program effectiveness and its effect upon them as individuals.

DATA COLLECTION PROCEDURE AND SAMPLE POPULATION:

On May 19, 1975 a survey was made of these seventy-one participating students to determine the effectiveness of the "Career Days" Program. Each student received an anonymous questionnaire on which he was to indicate his responses to questions regarding the effectiveness of the "Career Days" Program. Of the seventy-one participants, fifty-five completed and returned the questionnaire.

STATISTICAL TREATMENT:

Since the survey was to be descriptive in nature, no statistical manipulations were performed except those required to show response percentages.

SUMMARY OF STUDENT RESPONSE:

1. The Career Days Program provided valuable occupational information.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
32.7%	56.4%	9.1%	0.0%	1.8%

2. The Career Days experience helped me clarify my vocational objective.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
18.2%	49.1%	21.8%	7.3%	3.6%

3. The Career Days Program caused me to value my education more highly.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
9.1%	49.1%	30.9%	7.3%	3.6%

4. The Career Days Program helped me decide what to do after High School.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
18.2%	25.4%	38.2	10.9%	7.3%

5. The Career Days Program was:

A. 83.6% Of more value than classroom activities in helping me make a career decision.

B. 0.0% Of less value than classroom activities in helping me make a career decision.

C. 16.4% Of equal value with classroom activities in helping me make a career decision.

6. As a result of the Career Days Program:

A. 27.3% I have decided to continue my education after high school.

B. 3.6% I have decided not to continue ny education after high school.

C. 50.9% The Career Days Program was of no value in this decision.

D. 18.2 % Undecided.

7. The Career Days Program if repeated:

A. 56.4% Should be longer than this year.

B. 3.6% Should be shorter than this year.

C. 40.0% Should be repeated in its present form.

D. 0.0% Should be discontinued.

8. The Career Days Program:

A. 96.4% Was of more value than a guest speaker on a career topic.

B. 1.8% Was of less value than a guest speaker on a career topic.

C. 1.8% Was of equal value with a guest speaker on a career topic.

9. The Career Days Program:

A. 87.3% Was of more value than a movie about a career topic.

B. 5.4% Was of less value than a movie about a career topic.

C. 7.3% Was of equal value with a movie about a career topic.

10. The Career Days Program should be expanded and offered as a mini-course:

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
32.8%	18.2%	25.4%	20.0%	3.6%

11. The military portion of the Career Days Program:

A. 63.6% Should be condtinued and expanded.

B. 16.4% Should be discontinued.

C. 20.0% NO Opinion.

12. As a result of the Career Days Program:

A. 7.3% I have decided to join a branch of the military service after graduation.

B. 18.2% I have decided not to join a branch of the military service after graduation.

C. 67.3% The Career Days Program had no influence in this area.

D. 7.2% Undecided.

13. The Career Days Program should be offered:

A. 1.8% In the Sophomore year only.

B. 58.2% In the Junior year only.

C. 1.8% In the Junior High School only.

D. 27.3% At each grade level.

E. 0.0% It should be discontinued.

F. 10.9% In the Sophomore and Junior years.

14. Classroom teachers should spend more time on career education:

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
43.7%	40.0%	14.5%	0.0%	1.8%

15. Please make any comments you feel will clarify your feelings about the Career Days Program.

A total of twenty-nine students added comments about job assignments. Of those, twenty-seven thought the program was worthwhile and two were critical of their experience.

DISCUSSION:

It is clear from the student responses that the program had the anticipated positive effect. 89.1% of the respondents indicated that the program provided valuable occupational information. 83.6% indicated that the program was of more value than classroom activities in helping them make a career decision.

CONCLUSIONS:

The "Career Days" Program should be fruther sophisticated by expanding the number and variety of jobs available to students. Program participation should be limited to about one hundred students fro reasons of logistics and repeated for additional participants. Because of the above responses the Career Days Program should continue as an integral part of the High School Curriculum.

APPENDIX #2

SOPHOMORE CAREER MINI-TRIPS

INSTRUCTOR: Mrs. Flewelling

I. Florist, Greenhouse, and Interior Design Careers

Ten girls visited Butler Twins' Floral Center, Rollins Furniture Store, and the Capitol Area Regional Technical and Vocational School on March 7.

At Butler Twins', Mr. Richard Butler explained job requirements of a florist. He said that some schooling is involved and that one must be willing to work long hours, especially during holidcy seasons.

Mrs. Beverly Rollins Hall gave the group much information concerning the skills required in interior decorating. Using brochures, samples, and the furniture at Rollins Furniture Store, she gave students examples of the types of things they might do as an interior decorator.

At the Capitol Area Regional Technical and Vocational School, the students learned about greenhouse operation and the course that is offered at the School for students interested in working in a greenhouse.

II. Forestry and Parks and Recreation Careers

On May 15, about twenty students visited the Maine Forest Service field headquarters in Jefferson. There, both a forest ranger and a forester explained the jobs that they perform.

The main difference between a forest ranger and a forester, is that the forester must have a Bachelor of Science degree, while the ranger does not need a degree. Another difference is that the ranger spends much of his time with fire control. The forester is not directly involved with fire control.

The forest ranger is responsible for other jobs in addition to fire control. He must maintain his equipment and he spends alot of time trying to educate the public about fire control. He serves also as a law officer in cases where neglect has caused fires to burn out of control.

The service forester serves as an advisor to private land owners on matters concerning forest management. His services are available to the public at no charge.

Also on May 15, this group visited Reid State Park in an attempt to learn about careers in Parks and Recreation. The person who had planned to speak with us was uable to meet us on that day; so, one of the maintenance workers gave us a tour of the Park and explained what a maintenance worker does. He explained also that most jobs in State Parks are summer jobs only.

III Evaluation of Trips

The field trip of May 7 was extremely interesting. All of the students had very positive reactions. Some of them definitely plan careers as florists, greenhouse workers, or interior decorators.

The trip to the forest service was appealing to many of the students. There have been no comments about whether it affected career choices.

The trip to Reid State Park did not really fulfill the objective of learning about careers in Parks and Recreation. Probably, this trip should not be repeated.

PHYSICAL THERAPY FIELD TRIP

Instructor: Miss Bouton Students: 12

Institutions Visitied: Togus Rehabilitation Center - Cerebal Palsy Center

We visited Togus Rehab Center and observed therapy for burn patients, stroke patients, partially paralyzed individuals, and surgical recovery patients. We talked with the doctor in charge of P.T., plus the head supervisor of P.T.

We went through the physical therapy area and watched P.T. in action.

After our visit to Togus, we proceeded to the C. P. Center in Augusta. Here the students observed a physical therapist working with C. P. children. Each child had different problems and specific exercises were discussed for these children.

At the Center, some of the students took part in helping the P. T. do the exercises with the C. P. child.

The trip as awhole was informative, I feel. The students benefitted most of all from the C. P. Center.

For future trips I would recommend more participation by the students. Let them have a learn-by-doing experience. The students get more out of the outing and feel as though t ey are part of the program.

LAW DAY FIELD TRIP - MAY 22, 1975

Instructor: Sally Farrell

Institution Visitied: Superior Court and Law Library

The trip consisted of (1) A talk and question/answer period by Judge Naiman of the Superior Court

(2) A visit to the local jail

(3) A visit to the Law Library, State House

The trip, for vocational purposes, was not completely successful. The students did not learn about the types of law careers available. The program probably would have been better if we had had a chance to talk informally with people involved in "law" jobs.

PSYCHIATRIC AIDE FIELD TRIP

Instructor: Mr. Monroe

The trip was scheduled for the Augusta Mental Health Institute and the Veterans Administration at Togus. We Were not able to go to Togus, however, because of an emergency bus reshuffling.

At Augusta we were briefed on the set-up and then proceeded to tour several of the wards and special facilities for patients. We were able to see first-hand the many different occupations available at the hospital

The trip would have been better if we had gone to Togus.

AUTO BODY FIELD TRIP

Instructor: Mr. Monroe

This trip involved the touring of the Capitol Vocational School in Augusta, and Ray's Auto Body Shop in Manchester.

The students were able to find out what type of training was available at the Center and also what this training qualified them to do afterwards.

The students were more impressed with Ray's because they were able to see an actual job operation and also because of the motorcycles he sold and repaired.

I feel that this trip was greatly beneficial to the participants.

CAREER EDUCATION TRIP TO CRICKET SHOP 12/5/74

Damariscotta, Maine

Number of students: 7

Teacher: Nancy t. Roy

Objective: Santons- What are they? How are they made and distributed to the U.S.

Our group, plus Betty McCaslin, arrived at the Cricket Shop at 10:00 A.M. We waited till about 10:30 when one of the owners of the shop arrived to explain to us the history of the Santons (French clay figures- little Saints); they are manufactured, distributed and imported to the U.S. The Cricket Shop is the sole retailer in the U.S.

We learned that the French are not interested in making a living from the manufacture of Santons; with them the work is an avocation. When asked by the Cricket Shop for a $200.00 order, they refused saying it was too much work.

The Santons are relatively inexpensive; it is the import and duty fees which make them rather costly.

My students were greatly interested in the information given to them and asked numerous questions. After buying some Santons for their own collections, they were conducted on a tour of the storerooms to see how Santons are packed and shipped.

We left the Cricket Shop at about 12:30 P.M.; after stopping for lunch at a nearby restaurant, we returned to school at 2:00 P.M.

As a follow up, on 12/10/74, my French IV students brought their Santons to school and discussed what they had learned with the French I and French II classes. The group would enjoy visiting Provence in the south of France to gain first hand knowledge and experience on the making of Santons!

Career Education trip to the Augusta General Hospital 12-11-74

No. of Students: eleven

S. A. Webber- teacher

Our group arrived at the Augusta General Hospital in Augusta, Me., at 9:30 A.M.

Upon arrival we were taken to the private dining room and were greeted by Bryant Jones, Public Relations Director, who welcomed the group and explained the day's activities.

Mr. Jones then conducted the group on a tour of the hospital. Areas visited were as follows: maternity ward, maintenance facilities, purchasing and storage area, emergency room, cobalt and other radioactive treatment and lab area, testing lab area, and operating room/intensive care area. The group then returned to the private dining room.

Students participated in a question and answer period with a panel composed of the Associate Director of the hospital, head nurse, and director of social services.

Students were then placed with hospital personnel in their job areas. Students individually visited the following occupational areas: Dietary, Switchboard, Nursing, Administration, Stores, Psychology, Therapy, and Secretarial

The group ate lunch in the hospital cafeteria following job area placement.

Lunch was followed by a film presentation covering the importance of hospital careers.

The program ended at 1:40 P.M.

Follow-up by the teacher revealed that several students discovered that the career that they were thinking about was not as they had envisioned it and will consider a different career. Other students found that they may seek the career that they had considered but on a more challenging (higher) level. One student found that he may apply for a summer job in the career area he is considering. One student is considering changing future subjects to ones more in line with her career objectives.

APPENDIX #3

Marian Bagley in charge of Career Education in Maine. The state's present role in terms of funding and participation and also its future role in these areas.

4) Attendance at a discussion of the role of the state in the future of career education attended by Dr. Charles Ryan, coordinator and originator of Career Education in Maine; Marian Bagley, state coordinator; Woody Padlan, Director of Vocational Education; Saween Millet, Commissioner of Education; and various heads of departments of education.

5) Participation in a teacher workshop on career education put on by the South Portland Director Fred Freezie and his team of curriculum developers.

After studying various career education plans and projects, we make the following recommendations:

FOUR-YEAR CAREER EDUCATION PLAN

Grade 9

Study of the World of Work and acquaintance with the career clusters by the Guidance Director. Use of the Vocational Preference Inventory, Kuder DD Preference Test, and others to make a student aware of his abilities and interests in order that career decisions be made.

Grade 10

Study of the interests of the students and the development of mini-trips of small groups to various businesses and indust-

REPORT ON

CAREER EDUCATION SYSTEM DEVELOPMENT

Date: February 24-28, 1975

Teachers Involved:

Dennis Monroe, Chairman

Elaine Bean

Sumner Webber

Goals:

1) To learn what career education is, what it involves, and the philosophy behind it.

2) To investigate the extent and form in which career education is being infused into the curriculum of Maine schools.

3) To develope a plan by which career education can be infused into the curriculum of Hall-Dale High School.

Activities:

1) Day long visit of the South Portland pilot program including their resource center, junior high program, and their curriculum development corps of five teachers.

2) Day long visit to the Farminton Vocational Center where the first career education program was begun. An extensive look at their problems and progress was studied.

3) Visit to the State Department of Education and Mrs.

tries. Follow-up activities by the teachers involved is also recommended.

Grade 11

Participation in a three-day program of career awareness. Emphasis placed on placement of students in careers which they are planning to enter.

Grade 12

Placement into colleges, vocational schools, or the world of work.

CAREER EDUCATION IN THE CURRICULUM

1) Survey of all teachers by team to determine to what extent they are already placing some career education into their classes and also to discover the work records and interests of the teachers.
2) To aid teachers in the introduction of career education materials, find films, set up field trips and speakers for their classes.
3) Encourage teachers to make visitations to area businesses in order to discover how they can better present the relevance of their course to different occupations.

FUTURE RECOMMENDATIONS

1) Establishment of a Resource Room where all guidance and career information would be located. The ideal place would be the present room used as the clinic.

2) Establishment of a full-time guidance secretary whose duties would not only include the present ones but would also stock and replenish the information stored in the resource room.

3) That the person hired as the co-operative education director also be the junior high guidance counselor and career education coordinator.

4) That career education should be an ongoing process beginning in the elementary school and continuing through high school, rather than placing all the emphasis in just high school.

5) Coordination of all activities in all grades and at all levels so that there is as little repetition as possible.

FROM: Philip A. Watkins, Director of Counseling

TO: George D. Stewart, Superintendent of Schools and Members of the Board

THROUGH: Thomas E. Kelley, Principal

SUBJECT: Development of a Career Information Center for Hall-Dale High School

Consistent with the recommendations of Mr. Monroe, Mrs. Bean, and Mr. Webber, who studied Career Information Centers for one week under our Career Education Grant, it is recommended that a Career Information Center be developed for Hall-Dale High School.

2. Due to the present, very limited space, it is impossible to display career information materials, or permit small groups to use existing career information materials. Furthermore, there is no place where individual students can conduct career research or even preview college catalogs.

3. It is therefore, recommended that a Career Information Center be established according to the attached floor plan. Such renovation may be accomplished as follows:

(a) move Clinic to present Guidance Office upstairs.

(b) remove music stored in the Clinic and place it in the cellar, or rear of garage, or in the upstairs Guidance Office.

(c) the upstairs Guidance Office is not suitable for a Career Information Center due to its location and the inability to control materials and supervise students.

(d) install a door between Counselor's Office and the Career Information Center.

(e) move Guidance Secretary to the Career Information Center. (She should not continue to be the Attendance Officer. The Attendance Officer assignment is a conflict in "roles" for a Guidance Secretary and actually takes up about 85% of her work day.)

(f) Viewlex tabletop occupational film viewers, tables, and bookcases may be purchased as the budget permits. Much of the career resource materials are now on hand, but are somewhat scattered and inaccessable to students.

(g) the Guidance Secretary should divide her time between being Career Information Librarian, Guidance Secretary, Student Resource Person, Faculty Resource Person, in addition to other miscellaneous secretarial duties involved with grade averageing, keeping up permanent records, typing tranodripts, etc.

(h) the proposed renovations should be completed during the summer of 1975.

Philip A. Watkins

ACCESSION NUMBER: VT102527

PUBLICATION DATE: 31JUL75

TITLE: THE VOCATIONAL GUIDANCE AND PLACEMENT PROGRAM AT LEBANON HIGH SCHOOL. FINAL REPORT.

PERSONAL AUTHOR: HOLT, ROBERT S.; AND OTHERS

DESCRIPTOR: *VOCATIONAL COUNSELING; *INFORMATION CENTERS; *OCCUPATIONAL INFORMATION; *JOB PLACEMENT; *SECONDARY GRADES; GUIDANCE SERVICES; PROGRAM DESCRIPTIONS; SECONDARY EDUCATION

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 11P.

ABSTRACT: THIS PROJECT WAS CONCERNED WITH THE DEVELOPMENT OF A CAREER INFORMATION CENTER TO BE LOCATED IN THE LEBANON HIGH SCHOOL GUIDANCE DEPARTMENT IN LEBANON, NEW HAMPSHIRE. THE GOALS OF THE PROGRAM WERE TO INCREASE STAFF AND STUDENT AWARENESS OF CAREER OPPORTUNITIES, TO ENCOURAGE POSITIVE ATTITUDES CONCERNING THE VALUE AND AVAILABILITY OF VOCATIONAL GUIDANCE, AND TO EXPAND SERVICES TO VOCATIONAL STUDENTS. IN CARRYING OUT THE OBJECTIVES THE FOLLOWING ACTIVITIES WERE CONDUCTED: INTERIST SURVEYS WERE ADMINISTERED; WEEKLY STAFF MEETINGS WERE HELD TO IDENTIFY STUDENTS WITH SPECIAL NEEDS; DIAGNOSTIC AND PRESCRIPTIVE SERVICES WERE MADE AVAILABLE; AND STUDY WAS MADE TOWARD DEVELOPING STUDENT PROFILES. IN ADDITION, MATERIALS AND EQUIPMENT WERE PURCHASED FOR THE CAREER INFORMATION CENTER. VALUES CLARIFICATION CLASSES FOR DISTRICT PERSONNEL WERE OFFERED, A SIX-WEEK DECISIONMAKING UNIT WAS PROVIDED FOR JUNIOR HIGH STUDENTS, AND UNITS IN ORIENTATION TO THE WORLD OF WORK WERE INCORPORATED INTO THE VOCATIONAL CURRICULUM. THE JOB PLACEMENT COMPONENT WAS SET UP, AND A NUMBER OF IN-SCHOOL AND GRADUATING STUDENTS WERE PLACED. THIS REPORT DESCRIBES THE OBJECTIVES, PROCEDURES AND ACTIVITIES OF THE PROJECT. (NJ)

INSTITUTION NAME: LEBANON PUBLIC HIGH SCHOOL, N.H.

SPONSORING AGENCY NAME: NEW HAMPSHIRE RESEARCH COORDINATING UNIT FOR VOCATIONAL-TECHNICAL EDUCATION, CONCORD.; NEW HAMPSHIRE STATE DEPT. OF EDUCATION, CONCORD. VOCATIONAL-TECHNICAL EDUCATION DIV.

102 527

FINAL REPORT ON THE VOCATIONAL GUIDANCE AND PLACEMENT PROGRAM AT LEBANON HIGH SCHOOL

Project #5630

July 31, 1975

Submitted to: Dr. Lila C. Murphy
Research Coordinating Unit
State Department of Education
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Submitted by: Mr. Robert S. Holt
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VT 102 527

ABSTRACT

This project concerned itself with the development of a career information center to be located in the guidance department office with the following goals in mind:

1. Increasing staff and student awareness of career opportunities.
2. Developing positive attitudes regarding the value and availability of vocational guidance and counseling.
3. Expanding services to vocational students.

The collection of materials, the purchase of equipment, the provision of a vocational guidance and placement service component at Lebanon High School in Lebanon, New Hampshire were the specific tasks undertaken jointly be faculty, vocational staff, administration, and guidance personnel.

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CHAPTER ONE--INTRODUCTION

Rational and Need

Our experience at Lebanon High School for several years has been that non-college bound students arrive at graduation with little or no idea regarding their intentions after high school. An example of this is the fact that although two-thirds of the students are non-college oriented, Lebanon High School has one of the smallest percentages of high school graduates going on to post-secondary vocational-technical schools. We feel there are many reasons for this situation and, therefore, enumerate them below:

1. College-bound students have a specific goal and seek guidance and counseling in reaching for it.

2. As college admissions, financial aids, etc. becomes more complex and confusing, the process requires more and more counselor time for the same number of students.

3. Much of the curriculum is geared to the college-bound student.

4. Very little, if any, work is done currently on either the high school or junior high school level in terms of values clarification, career choice, vocational information, or curriculum specifications related to occupational choice and helping and encouraging students with this.

5. Since non-college-bound students frequently lack a specific goal, they do not tend to seek assistance as readily as the college-bound.

Statement of the Problem

Due to the felt need expressed above we agreed that priority would be given to the establishment of a career information center in the guidance complex and that every attempt would be made to increase staff and student awareness of career opportunities.

We recognized early that staff awareness would be the key to student awareness. Therefore, staff involvement in decision-making became a major

goal as we proceeded with material selection, equipment purchase, and center use. Overcoming the resistance to change that teachers have to new approaches in the classroom and at the same time soliciting their participation in the developing vocational guidance and placement component were the major obstacles to face throughout the year.

Specific Objectives

1. The Guidance Department will by June, 1975, cooperating with the administration and staff, have provided the vocational assessment of all students in Grades 9 and 10.

2. The school will conduct "staffings" on students identified as having special needs.

3. The guidance staff and the instructional staff will create a performance skills profile chart including a record of interests and aptitudes.

4. The Vocational Director and staff will complete a profile for all terminating vocational students.

5. The school will develop a profile for all 9th graders for implementing a four year profile.

6. The school will provide space, equipment, and materials in the new guidance complex for an occupational information resource area.

7. The school will attempt to increase knowledge of career opportunities and occupational characteristics on the part of staff and students.

8. The school will help students make wiser choices in selecting courses based on earlier career dicisions.

9. All vocational students will be exposed to a greater extent than ever before to knowledge of the World of Work.

10. The Vocational Department and the guidance personnel will develop and implement a job placement service for terminating students.

CHAPTER TWO--METHODOLOGY

Specific Activities Undertaken and Accomplished

A. Assessment

1. Interest surveys were administered and the results were available to students and parents, including time for counselor interpretation of results. (Ohio Vocational Interest Inventory)
2. Weekly staffings were held involving all school resource personnel to discuss students identified as having special needs. These staffings included vice-principal, principal, vocational rehabilitation counselor, learning disabilities consultant, alternative education coordinator, junior and senior high school guidance counselors, and school psychologist. Diagnostic and prescriptive services were then available to students so staffed.
3. Study was given to developing student profiles, but active work in this area toward the accomplishment of this activity will have to carry into another school year and the district is committed to this end.

B. Physical Development of Vocational-Information Center

1. The creation of a new guidance facility or suite in a different location provided the counseling personnel to have the space necessary to develop a listening center, student tables, shelves, wall space for projection purposes, and cabinets for the storage of various occupational information materials.
2. Many Center materials and equipment were farmed out to staff users

for a period of time that corresponded with classroom units dealing with career information.

C. Equipment and Materials

These are listed in a separate chapter.

D. Staff was encouraged to actively use the Center and the materials therein as part of their classroom programs. In-service workshops were conducted in the Spring to activate still more interest and promote the concept of availability of staff and materials, as well as equipment, to the entire school community.

E. Decision-making process

1. Values clarification classes were held for school district personnel by one of the guidance counselors.
2. Junior high students were exposed to a six-week unit on decision-making related to their future career choices.
3. A "Step-Up" Day for grades 6 through 11 was held to assist adjustments to next year s program.
4. Vocational staff included units in orientation to the World of Work in their courses.

F. The Job Placement Service

1. The beginnings of a coordinated effort to bring employers and prospective employees together was begun with the job placement component in the guidance office. Part-time and full-time placements were solicited and, although this was a tough year to find many placements, some students and employers were serviced, including in-school students as well as graduating students.

2. A Career Day program was held at which time various local employers came to the school and spoke to students about occupations in their various trades, businesses, and industries.

CHAPTER THREE—RESULTS

Summary

We feel that most of the objectives set for the vocational guidance and placement program at Lebanon High School were met in the time set for the project. There are many activities that were completed, and there are still activities that need to be brought to a more complete stage. A few activities were merely begun and the district appears to be committed to the continuation of these. We have attempted to spell out within the report the stages each of these various activities are at the present time. Certainly, the equiping of the guidance unit was the major task and this is a great improvement over previously existing situations in this office setting.

Conclusions and Recommendations

We are convinced that the key to making the vocational information center is going to rest with a greater involvement with personnel on the staff. Preliminary discussions of how best to continue the work started have taken place and we are approaching the point where we are almost ready to make specific recommendations to the administration in this regard. Among them, however, will certainly be requests for continuing in-service workshops with all staff members. Toward this end, the work accomplished this year has certainly set a more favorable stage for allowing this to happen during the forthcoming year.

Chapter Four--Equipment and Materials

In keep[illegible] with the intent of locating and operating the guidance and placement p[illegible] from the guidance office, it was necessary to purchase the following audio-visual and storage equipment:

A Singer SMI Slike - F8 Projector, Ektagraphic B-2 Slide Projector, Coxoo Municator, Projection Screen, Two 3 drawer file cabinets, Mirro Listening Center.

Discussions with administration, faculty, and students soon brought out the need to present career quidance in the light of the values and conditions that promote or impinge upon an individuals functioning.

With the point of view in mind and materials on hand for previewing, a workshop was held to evaluate the materials to decide if and how they could be used.

A variety of approaches were discussed and considered that would fit the personalities and classes who would be utilizing the materials. The latter comment accounts for the diversity in the materials purchased.

Set of 5 Captioned Filmstrips, Complete Job Survival Skills Program, Choosing your career Cassette - 611-1TC, Finding a Job Opening Cassette - 611-1TC, Your First Months on the Job Cassette - 611-3TC, You and the Changing World of Work Cassette - 611-3TC, An Introduction to Vocation Cassette - 788-1TC, Counseling in Vocational Decisions Cassette - C788-2TC, School Skills for Today and Tomorrow - Set of Six Captioned Filmstrips, Critical Areas of Health, Improving Your Study Skills (Gr. 7-12) - 4G-103 455, Better Choice, Better Chance: Selecting a High School Program (Gr. 6-9) - 4G-107 250, College? It's Up to You - 4G-100 139, Which College For You? - 4G-100 113, What to Expect at College? - 4G-100 154, Different Ways to to to College - 4G-103 414, SE-105 Achieving Adulthood, F785-SATC Popularity Problems of

Young Teens, Foultney Occupational Posters (POPS).

A most productive two day workshop, involving ten teachers and guidance was held to discuss methods of orienting staff and students to the broader "world of work." Several ideas and preferences were brought out that will be followed upon in the fall.

The major outcome of the workshop, however, was the interest generated in the direction of career exploration. The idea of setting up experiences and mini-courses utilizing representatives from industry, summer employment situations, seminars on industrial sites, etc., and tying in these experiences with the new teacher recertification proceedures.

Present Budget Status:

Budget Approved $3275

Expended $2639.80

Encumbered $479.16 prior June 30-75

Balance $156.04

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PERSONAL AUTHOR: FORTNEY, JANE H.

DESCRIPTOR: *CAREER EDUCATION; ELEMENTARY SECONDARY EDUCATION; POST SECONDARY EDUCATION; DEVELOPMENTAL PROGRAMS; *PROGRAM EVALUATION; PROGRAM DESCRIPTIONS

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 152P.; RELATED DOCUMENT VT 102 532 IN THIS ISSUE.

ABSTRACT: COVERING THE PERIOD OF JULY 1974 TO JUNE 1975, THIS REPORT DOCUMENTS THE SECOND YEAR'S ACTIVITIES OF A K-14 CAREER EDUCATION PROJECT IN THREE SECONDARY SCHOOLS IN ALLEGHENY COUNTY, PENNSYLVANIA. IN THIS SECOND YEAR, THE PROJECT STRESSED CURRICULUM DEVELOPMENT FOR THE INTERIM GRADE LEVELS IN CONTINUING TO INFUSE CAREER EDUCATION INTO THE ENTIRE COMPREHENSIVE CURRICULUM. BRIEF DESCRIPTIONS OF THE PROJECT ACCOMPLISHMENTS BY MONTH ARE INCLUDED, ALONG WITH EVALUATIONS BY FACULTY, AND THE U.S. OFFICE OF EDUCATION PROJECT REPORT. A BICENTENNIAL UNIT HIGHLIGHTING THE CAREERS OF FAMOUS AMERICANS IS ALSO INCLUDED. NEWS RELEASES AND OTHER PROJECT-RELATED MATERIALS ARE ATTACHED. (NJ)

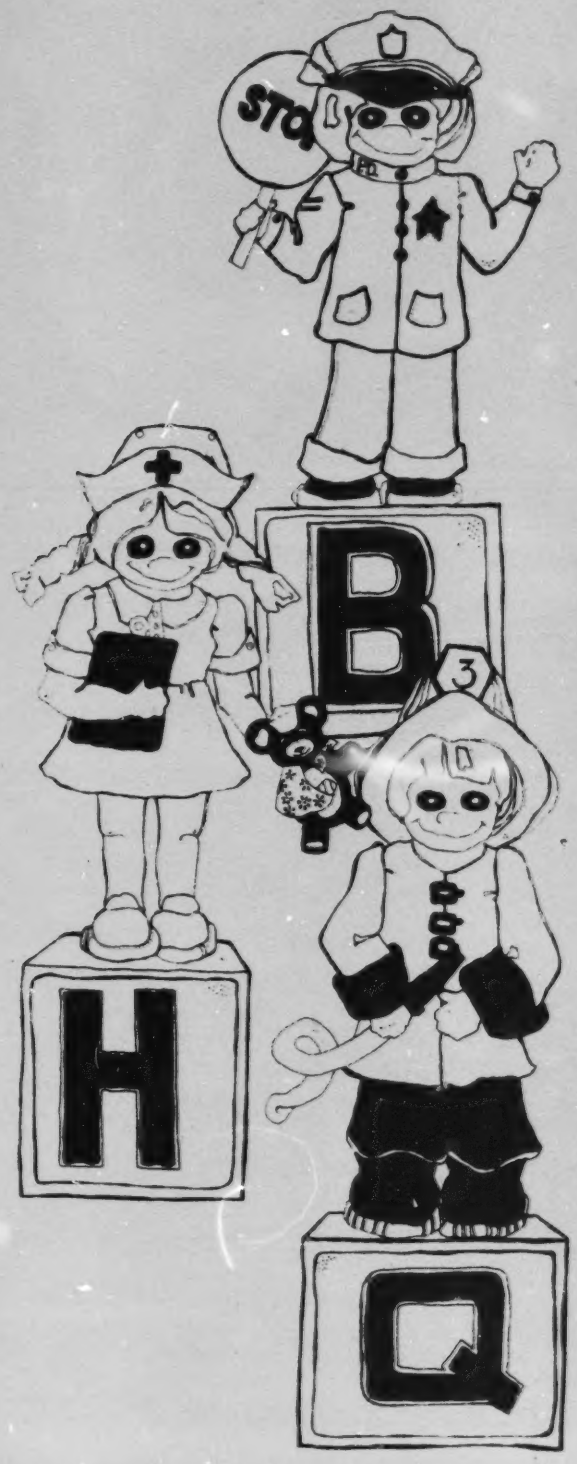
CONTRACT NUMBER: OEG-0-73-5276

INSTITUTION NAME: ALLEGHENY INTERMEDIATE UNIT, PA.

SPONSORING AGENCY NAME: OFFICE OF EDUCATION (DHEW), WASHINGTON, D.C.

10253

INTERIM REPORT
CAREER EDUCATION
PILOT PROJECT K-14



Allegheny Intermediate Unit
Two Allegheny Center
Pittsburgh, Pa.

August 1975

VT 102 531

2

INTERIM REPORT

Project No. 361093
Grant No. OEG-0-73-5276

"BHQ" CAREER EDUCATION
An Exemplary Project K-14

Exemplary Project in Vocational Education
Conducted Under
Part D of Public Law 90-576

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INTERIM REPORT

Project No. 361093
Grant No. OEG-0-73-5276

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The project reported herein was performed pursuant to a grant from the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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August, 1975

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SUMMARY OF REPORT

Period Covered:
July 1, 1974 -- June 30, 1975

GOALS AND OBJECTIVES OF THE PROJECT:

1. Through exposure to classroom instruction, field trips, and a variety of resources (human, print, non-print) and experiences, students will realize the practically unlimited possibilities for continuing self-development, both in the world of work and in self-awareness.

   As a result of the curricula, students will be provided with decision-making skills necessary for making appropriate choices from career alternatives available to them.

2. Given appropriate resources, the "BHQ" Careers Centers will develop a realistic process by which students, parents, and community will have increased utilization of information and resources vital to the decision-making points of the career development process.

3. As a result of in-service programs, faculty will develop positive attitudes toward career education as demonstrated in adaptation/adoption of career units and resources in their curricula.

4. Through early identification of handicapped and disadvantaged students, appropriate career counseling and other action as needed will be provided to minimize impediments to career choices.

5. Through personal contact and an intensive PR program, business, industry, parents, and the community will actively participate in the career program either as recipients or donors of services.

6. Through contacts in committees and continual communication, the "BHQ" Careers resource materials and curriculum models will be made available to all non-public, non-profit schools in the districts.

7. As a result of liaison with local business, industry, vo-tech. schools, community colleges, and other manpower agencies, their creative participation will be encouraged.

8. Through availability of resources in off-hours and special courses, provide a continuing career education program for grades 13, 14, and beyond.

9. Establish an exemplary program which will serve as a model for career education programs throughout the County of Allegheny and the Commonwealth of Pennsylvania.

PROCEDURES FOLLOWED:

The second year of this project has been to continue with the infusion of career education into the entire comprehensive curriculum, K-14. The stress for the first year was for grades 3, 6, 7, 10, and 12—this second year we have picked up curriculum development for the interim grade levels now giving us some involvement for all subjects at all grade levels to hopefully accomplish the philosophy that career education should meet the needs of all students at all levels through all subject material.

This program is a pilot in three of Allegheny County's school districts; therefore, the name BHQ—Baldwin Whitehall, Highlands, and Quaker Valley.

The fund cut for the second year has necessitated payment of only grade level coordinators rather than individual teachers; however, the fact that teachers continue to produce even on a voluntary basis is, we feel, indicative of commitment to the concept. The coordinators continue to function on a part-time basis in each of the districts. The project director remains as the only staff member employed full-time. All secretarial services are part-time.

The following monthly breakdown gives a more accurate method of administrative progress and accomplishments:

July

Editing teams in two days, each grade level to ready teacher card based file for production.
Sales representatives contacted for August Workshop.
Assistance with Churchill District In-Service.

August

Consultation for program implementation in Babcock and Wilkinsburg School Districts.
Attented Project Directors C and D Meetings, August 22 and 23, Baltimore, Maryland.
Teachers' workshop for new interim grade level leaders, August 26 through August 28, 1974. (Program included in addendum)

September

Continuum of in-service in-district by grade level leaders.
Orientation of Allegheny Valley to concept and resources.
Planning session for Highlands In-Service continuum.
Part D Project Directors' Meeting, September 19, Philadelphia.
Teachers' Meetings, grade levels.

September (continued)

Consultant for Northgate School District's career based Home Ec. Program.
Coordinators' Meetings to set goals and objectives, 1974-75.
Work begun on evaluation design.

October

Meeting with staff and previous evaluator to determine year's objectives and priorities.
Parent meeting, Baldwin-Whitehall to gain parental support and involvement in project.
Orientation and planning session for Moon Township School District.
Planning session and conference to assist implementation of career education in Mt. Lebanon School District.
Half-day in-service for newly involved Quaker Valley teachers.
Allegheny County Counselors' Association Meeting.
Half-day in-service (principal speaker) Canevin Senior High School (Secondary Parochial).
Career Education Planning Committee with Chamber of Commerce, Highlands.
Orientation meeting, counselors and administration, West Jefferson Hills School District.
Counselor conference, Shaler Area School District.
Conference with Department of Measurement and Statistics, University of Pittsburgh, concerning this year's evaluation.

November

Baldwin-Whitehall Teachers' Meeting.
In-service for Mon Valley Special School.
All day in-service for total staff, Highlands School District (see addendum).
Assistance with implementation of Elementary Introductive Program, Wilkinsburg School District.
In-service speaker for Allegheny Valley School District.
Card file reproduction and dissemination for grades levels 3 and 6.
Served as chaperone on trip to United Nations during the Middle East Crisis episode.

December

Assistance in planning and participation in all day in-service in Beaver County, for New Brighton District Intermediate Unit #27. This was a total model to give direction to Beaver County's future involvement in career education.
Reproduction, collation, and dissemination of card file, grades 7 and 10.

December (continued)

Requests for proposals from evaluators sent.
Bids received and evaluated.
Contract submitted to U.S.O.E. for approval.
Preliminary meetings held to determine design and instruments for pre-test segment.
Space and materials allocation for the establishment of Jr. High CRC's.

January

Pre-test segment of evaluation was begun with dissemination of instruments.
Churchill School District Administrators and counselors oriented to Career Education.
Card dissemination completed to all grade levels.
Meetings with Career Education Planning Committees.
All three segments of the project were seen and reviewed by the Director of Instructional Services, Allegheny Intermediate Unit.
Formation of a steering committee to coordinate Career Education activities in the Allegheny Intermediate Unit.
Meeting held of the AIU Steering Committee.
Teachers' Meeting, Baldwin-Whitehall.
Attended the National Coordinating Conference for Administrators of Parts C and D Projects, January 27-30, Dallas, Texas.
Served as a chairman for Project Directors' segment of the above.

February

Coordinators' Meetings.
Highlands--planning and sponsorship of Career Day (see inclusions in addendum).
Continuation of pre-testing.
Assistance to Bethel Park District with career orientation.
Presentation for Duquesne University undergraduates as pre-service for future teachers.
Sat in as public school representative with small private colleges to recommend curriculum changes to increase their dropping enrollment.

March

Orientation visit by Earl Dodrill, representing the U.S.O.E.
Conference with editor of Career Magazine, Dialogue.
Orientation conference with South Fayette School District.
On-site visit (2 days) of evaluation team, ERANDA.
Attended conference on Career Education at Ohio State Univerity with two of the district coordinators.
Soft data gathered by Dr. Janet Siedel, of ERANDA.

April

Seminar with Gulf Oil at Chatham Center
Consultation and planning with Bethel Park District
Hosted the USOE Evaluation Team, April 8-10 (report included)
Penn State Planning Session for Workshops
General Teacher Presentation and Orientation for South Fayette District
Presentation and Workshop with Bethel Park District
Workshop for University of Pittsburgh Foreign Language and Social Studies Teachers
Presentation for group of undergraduate education majors from Slippery Rock College
Served as a member of the United States Office of Education Evaluation Team in Parkersburg, West Virginia
Presentation for Allegheny Intermediate Unit School Board Convention

May

Consultation meeting with Churchill School District
Post-tests disseminated
Groundwork done for possible courses with Allegheny County Firefighters and Police Academy
In-district, on-site visits to districts with ERANDA--Dr. Janet Seidel for soft data collection

June

Proposal submitted to Harrisburg for supplemental funds for reproduction and dissemination of materials
Post-test segment completed and forwarded to ERANDA
Served as member of Allegheny Intermeidate Unit's Steering Committee for Career Education
Baldwin-Whitehall held a three-day workshop for teachers
Quaker Valley had a three-day work session to organize and research resources into a comprehensive file
Work session with Penn State University for counselor workshop and secondary, post-secondary seminar
Printing and collation of 12th grade Language Arts file

RESULTS; ACCOMPLISHMENTS

The first year we produced a teacher card file system of approximately 800 resource cards on the original 5 grade levels. This year, the second, we have produced approximately 1500 more on the interim grade levels to give us total comprehensive coverage, K-12. We have already distributed the completed files to all districts in Allegheny County and have found the system flexible enough to be adapted or adopted by any district of any size. Through this approach, we have found ways to reach the following objectives:

1. Promote a vocational-academic fusion approach to the teaching process.

2. Integrate career opportunities and decision-making into every day learning.

3. Involve students in the learning process through hands-on activities which reflect the academic material learned.

4. Stimulate in teachers a desire to teach through real world application.

5. Provide easily accessible resource lists and materials to teachers.

6. Build interest and commitment to Career Education in Allegheny County.

7. Encourage by example more methods within individual curricula.

Growth of involvement has been seen not only in the numbers of teachers trying various classroom activities, but more and more community members and businesses have come forth to offer their resources, support, and facilities.

Among other observations we have made, is the fact that career education programs cannot be "prescribed." Among the many districts with which this program has had contact, we see a necessity in each to maintain its autonomy. The degrees of success and/or involvement will vary due to:

1. The traditionalism of the academic approach to education and hence the teacher resentment level to be overcome.

2. The degree of administrative support given both through action and word, i.e., time for in-service--in-district material purchase, etc.

3. Counselor-role and assignment within that district as well as time or personnel assigned to placement.

4. Availability of human resources and willingness of parents and community to participate.

5. The geographic location of district, rural or urban, will determine the limitations of field trips, community resources, and exploration sites.

These five points as we have indicated would seem to determine the potential of the success within any given area and, therefore, any plan for development and approach must have the quality of flexibility so that the criteria established be malleable.

EVALUATION

The third party evaluation this year was done by Educational Research and Development Associates, West Chester, Pennsylvania.

The Evaluation Design is included in the following pages of this report. Due to the delay of the establishment and dissemination of the Federal Guidelines, the pre-test phase was done in February and the post-test in May giving us a measurement of three months, hardly considered by anyone to be a valid measurement of a total year's change. The instruments identified were somewhat unsatisfactory, at least to our individual project. All three districts flatly refused to administer the SOS which was originally specified in the design. As an alternate, we used the Inferred Self-Concept scale filled out for students by teachers according to directions. They were to be done as the teacher first saw the students in September. The other instrument, CEQ, was objected to by most of the teachers giving the test as "even I don't know the answers, how can they?" It was the feeling of most students who took the test by an eeny, meeny, miny, mo system. How valid can the results, therefore, be? We hope that before other projects are saddled by these types of guidelines, they would be: 1) revised, and 2) better instruments would be developed.

The evaluation report accompanies this one as a separately bound volume.

CONCLUSIONS AND RECOMMENDATIONS:

The present method of evaluation has proven to be most unsatisfactory. In contact with other projects, it was found most chose instruments that were feasible both due to limitation expenses and the classroom testing time allocation permitted by administration. Some could not be used because of the fear of parents objection and legal implications. We would conclude that individual projects should be encouraged and some funds allocated for the development of some new evaluation instruments. We would also conclude that the proof of the pudding is in the product and that three years will not measure any real change in kids. None of us will be able to determine in any less than 10 years the attitudinal changes nor the adjustments to the real world our methods will make on the students we teach today. However, teachers dedicated to career education verbalize higher interest levels and a meaningful retention level increase when learning is made revelent and applicable. This should be measured. Much more weight of evaluation must be through soft data collection, parental reaction, and gut level feelings than can be calculated with attest. The most important things in all of life cannot be measured accurately--love, caring, sharing, and self-worth. The measurement of educational learning in any testing situation has long ago been proven to be poor, yet we continue to insist now on measurement of a much more intangible force. The only yardstick available is yet far away--the success of our youth in and throughout their total life situation.

The only objective that we have found to be most difficult to achieve, and we have tried, was that listed as number 8.

"Through availability of resources in off-hours and special courses, provide a continuing career education program for grades 13, 14, and beyond."

We have paid counselors and have kept the Career Resource Centers open evening hours and during the night school schedule to find they are not used at all or on a very minimal level. One of our local libraries even attempted a series of evening career programs for the community, it was well publicized (local newspaper, posters, etc.), attendance was so poor that after two it was decided to cancel the venture.

It would seem, however, that a new approach could be attempted for the third year through the vo-techs, since their evening programs seem to function with a great deal of success and it might seem probable that many of these people might be in process of retraining for a change of career direction.

EVALUATION DESIGN

FOR CAREER EDUCATION PROJECT

GRANT #OEG-0-73-5276

FUNDED THROUGH PART D

OF PUBLIC LAW 90-576

Submitted to: Ms. Jane Robertson
Project Director
Pittsburgh, Pennsylvania

Submitted by: Martin J. Higgins
Ernest L. Peters

EDUCATIONAL RESEARCH AND DEVELOPMENT ASSOCIATES
28 West Market Street
West Chester, Pennsylvania 19380

Comments

The following evaluation design was developed in accordance with the Scope of Work Statement released by the Project Director and the evaluation guidelines formulated by Development Associates, Inc. for the U. S. Office of Education. The major problems encountered were:

(1) Severe reductions in project funding level with consequent restrictic of evaluation activities. Emphasis has been placed on student outcomes or products. Very few resources are available to evaluate the educational process (treatment) or project management.

(2) Differences between the objectives previously identified by project personnel and those contained in the Scope of Work Statement (six) and the evaluation guidelines formulated by Development Associates, Inc. (thirty-three). Considerable effort was expended cross referencing the various sets of objectives and determining the relative emphasis placed on them by the project.

(3) The evaluation guidelines and Scope of Work Statement were released too late to be incorporated in a September to May design. This has forced projects into evaluating a segment of the year's activity.

I. Evaluation Questions

The Evaluation questions are naturally a function of the project's objectives. The objectives in terms of student outcomes are as follows:

Scope of Work #	USOE#	Objective	Grade Level
1	I c	Students will display positive attitudes toward themselves	3, 6
1	I d	Students will recognize that social, economic, educational and cultural forces influence their development	9, 12

Scope of Work #	USOE#	Objective	Grade Level
2	IV a	Students will know the major duties and required abilities of different types of paid and unpaid work	3, 6, 9, 12
2	IV b	Students will know differences in conditions and life styles associated with different types of paid and unpaid work	3, 6
2	IV c	Students will know entry requirements for major types of paid and uppaid work	6, 9, 12
3	V c	Students will be able to identify, locate and utilize sources of information to solve career decision-making problems	9, 12
3	V e	Students will know the steps to be taken and the factors to be considered in career planning	9, 12
3	V f	Students will demonstrate active involvement in career decision-making	9, 12
4	VIII	Students who are leaving the formal education system will be successful in being placed in a paid occupation, in further education or in unpaid work that is consistent with their career decision	12+
5	NA	The extent to which the number and type of job preparation opportunities have been expanded for young people in grades 10 through 14	10 to 14
6	NA	The financial resources from Section 142 (c) of Part D of P. L. 90-576 that were expended at each of the grade level breakouts	K to 14

The evaluation questions are specific to each objective and with the exception of objectives 4-6 are stated in pre-post, non-control group terms. For example, the evaluation question appropriate to Objective 1 is:

(1) Do students participating in the Career Education program show statistically significant improvement in positive attitudes toward themselves as measured by the Self-Observation Scales at grades 3 and 6?

The objectives and evaluation questions are primarily concerned with student outcomes. The only evaluation activity directed toward Treatment (Process) or Management will be observations, questionnaires, teacher logs, etc., to determine if educational activities previously mentioned were actually conducted.

II. Evaluation Design

The evaluation design to be employed with objectives 1 through 3 is a pre-test, post-test non-control group design. Campbell and Stanley[1] refer to it as pre-experimental design #2. It provides marginal protection against the threats to internal and external validity. The major reasons for selecting this design are as follows:

(1) Career education activities exist in all schools to which the project has access. A non-contaminated control group could not be located within the districts.

(2) Lack of lead time prevented the staff from overcoming a natural reluctance to serve as a control group on the part of non-district classes.

(3) A reduced funding level required cuts in the program's educational activities. Even if a control group could be located (unlikely) it would be difficult to justify diverting the additional $1,000 required for testing from program activities to evaluation.

It would be desirable for USOE to fund a study to determine normal growth rates for various pre-post test intervals on the instruments approved by

[1]Campbell, Donald T. and Stanley, Julian C., Experimental and Quasi-Experimental Designs For Research on Teaching

its panel. In this way any project's pre-post gains could be compared to a contrast group of similar socio-economic background children not involved in Career Education.

Objectives 4 and 5 will be criterion referenced. The criteria for Objective 4 is that 75 percent of the responding students (1974 graduates) indicate that they have been successful in locating a paid occupation, further education or unpaid work consistent with their career decision. The criteria for Objective 5 is a 20 percent increase in the number and type of job preparation opportunities for students between the current year and the year preceeding the project.

Objective 6 consists of allocating all expenses to the grade categories provided.

III. Data Sources

For Objectives 1, 2, 3 and 4 direct data sources will be employed. In Objectives 1, 2 and 3 current student test data will be utilized. For Objective 4 current questionnaire responses of a random sample of recent graduates (1974) and dropouts will be gathered. Objective 5 will have questionnaire responses of counselors and Coop-directors as the data source. The source of data for Objective 6 will be the financial records of the Project Director.

IV. Data Collection Instruments

The data collection instruments associated with the various objectives are as follows:

Scope of Work #	Objective USOE #	Instrument	Grade Level
1	I c	Self-Observation Scales	3, 6
1	I d	Career Development Inventory-C	9, 12

Scope of Work #	USOE #	Instrument	Grade Level
2	IV a	Career Education Questionnaire Career Development Inventory - C	3, 6 9, 12
2	IV b	Career Education Questionnaire	3, 6
2	IV c	Career Education Questionnaire Career Development Inventory - C	6 9, 12
3	V c	Career Development Inventory - C	9, 12
3	V e	Career Development Inventory - C	9, 12
3	V f	Career Development Inventory - A & B	9, 12
4	VIII	Questionnaire to 1974 Graduates and Dropouts	12+
5	NA	Questionnaire to Counselors and Co-op Directors	10 to 14
6	NA	Examination of Project's Financial Records	K to 14

All standardized instruments have been approved for these objectives by the USOE panel.

V. Sampling Plan

The approximate distribution of participating students across school districts is as follows:

Grades	School Districts: Baldwin-Whitehall	Highlands	Quaker Valley
K-3	600 (90)	400 (60)	200 (30)
4-6	450 (90)	350 (60)	200 (30)
7-9	600 (90)	450 (60)	200 (30)
10-12	900 (90)	550 (60)	250 (30)
Totals	2,550 (360)	1,750 (240)	850 (120)

Since the ratio of school district size is approximately 3:2:1, a stratified random sampling of these proportions will be employed at grades 3, 6, 9 and 12. This results in a very representative sample of 15 percent. The sample sizes are shown on page five in parentheses.

A random sample of 180 1974 graduates and dropouts will be selected in the same proportions. This will yield sample sizes of 30 in Quaker Valley, 60 in Highlands and 90 in Baldwin Whitehall to determine the extent to which Objective #4 (USOE #VIII) has been met.

VI. Data Analysis Plan

For objectives 1, 2 and 3 a pre-test, post-test non-control group design will be employed. The data will be analyzed by grade level using the correlated "t" test at the .05 level (two-tailed). The data will also be analyzed by strata (school or district). Objectives 4 and 5 are criteria referenced and will be handled in that manner.

VII. Data Collection Plan

The data collection plan is depicted in Table X-B. ERANDA will order, distribute and score all tests and questionnaires. The tests will be administered by experienced classroom teachers familiarized with the tests by the Career Education Coordinators.

IX. Reporting Plan

The pre-test data will be processed and reported to the Project Director by February 15, 1975. The final report will be submitted to the Project Director by June 15, 1975. Twenty-five (25) copies of the final report will be provided for whatever distribution the Project Director sees fit. ERANDA will make one presentation of the final report to any local individual or group at the request of the Project Director.

Additional presentations will be at the rate of $100 per man day plus expenses. In addition to the product evaluation, ERANDA will make periodic visits to confirm the existence of the stipulated process. Their will be an exit interview after each visitation to inform the Project Director of any discrepancy while there is time for remedial action.

Table X-B

DATA COLLECTION
PLANNING CHART

(1) TASK	(2) Completion Date	(3) Prime Responsibility	(4) Support Responsibility
1. Administer Self-Observation Scales Grades 3, 6	15 January 15 May	Classroom Teacher*	Career Ed. Coordinator
2. Administer Career Development Inventory Grades 9, 12	15 January 15 May	Classroom Teacher*	Career Ed. Coordinator
3. Administer Career Education Questionnaire Grades 3, 6	15 January 15 May	Classroom Teacher*	Career Ed. Coordinator
4. Administer Questionnaire to Random Sample of 1974 Graduates and dropouts	15 April	ERANDA	Career Ed. Coordinator
5. Administer Questionnaire to Counselors and Coop Directors	15 April	ERANDA	Career Ed. Coordinator
6. Examine Project's Financial Records to determine allocation of funds to each grade breakdown	1 June	ERANDA	Project Director
7. Order, distribute and inventory all tests	15 December 15 April	ERANDA	Project Director
8. Score all tests and questionnaires	1 February 1 June	ERANDA	Project Director
9. Review all tests with Career Ed. Coordinators	1 December	ERANDA	Project Director

*Experienced teachers trained in test administration by ERANDA and Career Ed. Coordinators

EVALUATION-DESIGN WORKSHEET

//	Student Outcome Area	Outcome Question	Related Evaluation Questions	Design	Data Sources	Instrumentation	Sampling	Data Analyses
c	Increased self awareness	Do students display more positive attitude toward themselves?	Evaluation is student outcome oriented. Existence of treatment or process aspect is validated via observations, logs, etc.	Pre-test Post-test Non-Control Group Design	Participating students	Self-Observation Scales	Stratified Random Sample Grade 3 = 180 Grade6 = 180	Means, standard deviations, correlated "t" test .05 level two tailed
d	Increased self awareness	Have students increased their recognition that social, economic, educational and cultural forces influence their development?	Same as above	Same as above	Same as above	Career Development Inventory	Stratified Random Sample Grade 9 =180 Grade 12 =180	Same as above
a	Increased awareness of and knowledge about work	Have students increased their knowledge regarding the major duties and required abilities ofndifferent types of paid and unpaid work?	Same as above	Same as above	Same as above	Career Education Questionnaire Grades 3, 6 Career Development Questionnaire Scale C Grades 9, 12	Stratified Random Sample Grade 3 = 180 Grade 6 = 180 Grade 9 =180 Grade 12 =180	Same as above
b	Increased awareness of and knowledge about work	Have students increased their knowledge of differences in work conditions and life styles associated with different types of paid and unpaid work?	Same as above	Same as above	Same as above	Career Education Questionnaire	Stratified Random Sample Grade 3 = 180 Grade 6 = 180	Same as above

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EVALUATION DESIGN WORKSHEET

Student Outcome Area	Outcome Question	Related Evaluation Questions	Design	Data Sources	Instrumentation	Sampling	Data Analysis
Increased awareness of and knowledge about work	Have students increased their knowledge of entry requirements for major types of paid and unpaid work?	Evaluation is student outcome oriented. Existence of treatment or process aspect is validated via observations, logs, etc.	Pre-test Post-test Non-Control Group Design	Participating students	Career Education Questionnaire Grade 6 Career Development Inventory Scale C Grades 9, 12	Stratified Random Sample Grade 6 = 100 Grade 9 = 100 Grade 12 = 100	Means, standard deviations, correlated "t" test .05 level two tailed
Increased Career Decision-Making Skills	Have students increased their ability to (a) identify, (b) locate, and (c) utilize sources of information to solve career decision-making problems?	Same as above	Same as above	Same as above	Career Development Inventory Scale C	Stratified Random Sample Grade 9 = 100 Grade 12 = 100	Same as above
Increased Career Decision-Making Skills	Have students increased their knowledge of the steps to be taken and the factors to be considered in career planning?	Same as above	Same as above	Same as above	Career Development Inventory Scale C	Stratified Random Sample Grade 9 = 100 Grade 12 = 100	Same as above
Increased Career Decision-Making Skills	Have students increased their active involvement in career decision making?	Same as above	Same as above	Same as above	Career Development Inventory Scales A & B	Stratified Random Sample Grade 9 = 100 Grade 12 = 100	Same as above

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EVALUATION DESIGN WORKSHEET

Student Outcome Area	Outcome Question	Related Evaluation Questions	Design	Data Sources	Instru-mentation	Sampling	Data Analyses
Placement	A. How many students have been placed or are engaged in further education and how does this compare with prior years? B. How many students have been placed in a paid occupation, and how does this compare with prior years? C. Of those placed in (a) further education, and (b) employment, how many consider the placement to be consistent with their career plans? D. Of those not placed in further education or in a paid occupation, how many are engaged in (a) unpaid work consistent with their career plans, and how does this compare with prior years?	Base line data as to prior years is not available. We have therefore criterion referenced this objective to be that 75% of the responding students indicate: a. They are placed in further education or employment b. They consider this placement to be consistent with their career plans	Criterion Referenced	1974 graduates and dropouts	Questionnaire	Stratified Random Sample N = 100	Percentages for each response

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Baldwin-Whitehall School District

MEMORANDUM

To: BHQ Project Director

From: Harlan E. Nelson, Baldwin-Whitehall Coordinator

Subject: Quarterly Report - April, June

Date: August 8, 1975

Following are some of the significant accomplishments for the fourth quarter:

1. Career Resource Center

The Career Resource Center at Baldwin High School continued to make a significant contribution to the career education program in the district. The number of teacher requests for use of material continued to increase. Concentration of a major share of the career materials remains at this facility where it can be conveniently moved through inter-school mail at the telephone requests of classroom teachers. The facility was used by approximately 1300 students during the last school year. The CRC was also open two evening's each week in conjunction with the Community College program conducted in the building. A counselor was on duty to provide guidance and career information. However, utilization by post-graduate students was very limited even though the evening hours were well publicized and announced in Community College classes.

The addition of new career materials will further enhance the use of the facility by classroom teachers at the elementary and middle school level.

2. Senior Career Elective program was highly successful with approximately 180 seniors participating. Students were released from two to four weeks to receive an on-the-job orientation and work experience in selected careers and professions.

3. The Intermediate High School careers programs, which have become a formalized part of Social Studies curriculum, were conducted in our two Intermediate High Schools. Approximately seven days of each reporting period (9 weeks) is devoted to career research and classroom programs. Every 9th and 10th grader participates in these activities four times each academic year. The program is closely tied with counseling and testing to provide students and parents with as much guidance as possible in making future course selections.

4. Aeronautical Training

Final plans have been completed for offering Aeronautical vocational skills through an agreement with the Pittsburgh Institute of Aerounatics. Students from 11th and 12th grades will spend one-half of each day at Baldwin High School in an academic program and the other half in this new vocational program. Starting date for this new offering will be in September 1975.

5. Career Fair was conducted in grades 9-12 on April 29th. Parents and students were invited to attend and given an opportunity to hear speakers from forty different careers. Representatives from colleges, vocational schools, technical schools, and the armed forces were also available for information. Financial aid experts were in attendance to provide advice on educational loans and grants. More than 800 parents and students attended these sessions and responses to survey forms showed a great deal of acceptance by parents and students. Attached are copies of the Career Fair Program.

6. In-Service Training

A major in-service program on career education was conducted in the district during the month of June with approximately fifty teachers and counselors participating. The purpose of the workshop was:

a. Finalization, development, and expansion of the curriculum cards system to provide more coverage for all grade levels.

b. The expansion of a Resource file of outside agencies of people willing to visit classrooms or offer their business for career orientations.

c. Development of new program ideas and organizations for the next school year.

d. Develop plans for Career Fair in the next school year.

To accomplish these objectives the selected participants were organized in eight committees. The results were a wide variety of new and inovative ideas for incorporating career education into the regular classroom in all academic areas. A new and larger career fair is being planned for October, 1975. The Resource file of outside agencies was expanded considerably. Two new and more formalized programs have been developed to be incorporated in our two middle schools and ten elementary libraries. The elementary librarians have developed a program of featuring the careers of famous people in our history and ideas on activities related

to the career. The interest is two-fold in promoting career education and developing a better understanding of our history and heritage as a part of the bicentennial year. Copies of these new programs are attached.

7. The career education organization in the district will change in the coming year from grade level committees to building coordinators.

HEN/aoh

CAREER EDUCATION

One of the proposals made by the Middle School group involved in this project was to select seven (7) career courses to be presented as monthly programs in which specific classes are emphasized, explored and developed through the Guidance Counselors, Librarians, and classroom teachers.

The following outline is provided to demonstrate how a particular career cluster can be presented to students.

NOVEMBER - BUSINESS AND OFFICE CLUSTER

1. Publicize interest of one month

   a. Posters - Bulletin Boards & P.A. System
   b. Discussion in typing classes

2. Speakers - interested students may sign up to meet with representatives of this cluster. Speakers will be scheduled (through counselors) according to number of students expressing interest in discovering more about this area of work. Meetings will be set up during study hall periods.

   a. Medical Secretary
   b Court Stenographer
   c. Business School Representatives
   d. Films

3. Faculty Cooperation

   a. Meet to discuss and decide where and how monthly Career Cluster fits and may be developed within existing curriculum for presentation to whole classroom sections.

   b. Reinforce use of career folders with classroom activities and bibliography of available materials.

4. Supervise follow-up activities when and if warranted or appropriate.

   a. Meet in Library (under supervision of librarian and/or counselors) to investigate available literature and materials.

   b. Individual explanation for specific personal interests.

PAYNTER MIDDLE SCHOOL

MONTHLY CAREER CLUSTER TO BE HIGHLIGHTED

October	-	General Introduction to Careers
November	-	Public Service
January	-	Manufacturing
February	-	Health
March	-	Fine Arts and Humanities
April	-	Construction
May	-	Business and Office

HARRISON MIDDLE SCHOOL

MONTHLY CAREER CLUSTERS TO BE HIGHLIGHTED-

October	-	General Introduction to Careers
November	-	Business and Office Cluster
January	-	Construction Cluster
February	-	Fine Arts & Humanities Cluster
March	-	Health Cluster
April	-	Manufacturing Cluster
May	-	Public Service Cluster

To: Faculty of Middle School

From: Career Education Workshop

Subject: Use of Career Cards in Classroom

Date: August 28, 1975

I. Objectives:

A. Each student will recognize the relationship of academic skills to life skills.

B. Each student will have the opportunity to learn more about many occupational areas and will be able to explore and understand those areas in relationship to his/her own specific interests.

C. Each student should be able to understand the relationship of subject matter to certain aspects of the work world.

II. Description of cards:

A. Each card contains a suggested classroom activity that can be written into a teacher's lesson plans.

B. Each card also contains suggested materials that are available at the school libfary, the career resource center at Baldwin High School, or from the AIU Resource Center.

C. These cards are designed as ideas to be included in lessons, not lesson plans by themselves.

D. Each card has a subject area code in the upper right hand corner.

A & H	Arts and Humanities
G	Guidance
LA	Language Arts and Communication
M	Math
Sc	Science
SS	Social Studies

III. Implementation

A. Cards are filed according to career clusters.

B. A.V. materials for each cluster are listed according to career clusters on attached sheet.

C. Following an introduction to careers, a career cluster will be spotlighted by library, guidance, and teachers each month during the school year.

III. Implementation (Cont'd)

D. Librarians and guidance counselors will have cluster packets for each "cluster of the month." Teachers may use these to incorporate career activities into lesson plans.

E. Career films, along with other A.V. materials (microfiche, SRA kits, Popeye Career Comic Book series), will be available for use during study hall time.

INTRODUCTION

An introduction to the world of work and careers. Procedures for finding a job, and getting and keeping a job, i.e. interview, finding a career, applications.

AV MATERIALS

Kit X-340 (7-12)	-	Finding Your Job
Kit 7-5 (7-12)	-	The ABC's of Getting & Keeping a Job
Kit 206	-	Preparing for an Interview

AIU

Film V1030	-	Understanding Ourselves

BUSINESS AND OFFICE

Typing, storing, studying and distributing records of people's work. Jobs with typewriters, computers, copying machines and records.

AV MATERIALS

Kit 407	-	Data Processing
Kit401	-	Clerical Occupations
Film 9	-	A Career in Computers

AIU

Film P2094	-	Posture & the Keyboard
Film B1035	-	Business Machine Operations
Film C1103	-	The Computer
Film C2126	-	The Computer Revolution
Film A2174	-	Arithmetic is Important

CONSTRUCTION

All activities in building. Jobs with cement, plastic, wire and tile.

AV MATERIALS

Kit 8-4 (7-12)	-	Building Trades Workers
Kit 415	-	Building Trades
Film 3	-	A Career In Engineering
Film 4	-	A Career in Construction

AIU

Film A1109	-	Air Traffic Controller
Film A2069	-	Airport in the Jet Age
Film A2177	-	Aviation Mechanics
Film C2123	-	Careers in Engineering
Film C1086	-	Careers in Lesiure Industries

FINE ARTS AND HUMANITIES

Creating, writing, performing, & studying. Jobs with music, plays dance, poetry, art, novels, history, and languages.

AV MATERIALS

Film 12	-	Photography Is
Kit 156	-	Photography Is
Kit 153	-	Idea's Won't Keep
Kit 202	-	Worlds Within Worlds

AIU FILMS

T2104	-	Textile Industry Careers
W2087	-	Weaving
L1093	-	Loops & Pens Point Percussion
P2083	-	Prints
P2123	-	Four Artists - Tour Media
A1093	-	Art
A1089	-	Art & You
T2069	-	Two Baroque Churches in Germany
B2090	-	Bouquet
A1017	-	About Flowers
W4001	-	Williamsburg Restored
C2116	-	Careers in Art
L1075	-	The Loom
P1017	-	Penn and the Quakers - PA Colony
A1082	-	Acting Without Words
P2116	-	Pantominme for the Actor
S2218	-	Spaces Between People

HEALTH

Care and repair of the human body and mind.

AV MATERIALS

H-357 (7-12)	-	Hospital Job Opportunities
Film 6	-	A Career in Health Services
Film 8	-	A Career in Nursing

AIU

J2036	-	Medicaine and Health
J1012	-	Health
I3011	-	Medical Laboratory

MANUFACTURING

The making of anything not found in nature. Designing, assembling, producing, packaging, advertising, and transporting.

AV MATERIALS

Kit X-338 (4-9)	-	Field Trips out of the Ordinary
Kit 403	-	Repair and Maintenance
Kit 404	-	Automotive Repairs
Kit 410	-	Plastics Forming and Design
Kit 412	-	Metalworking - Mfg. II

AIU

C2172	-	Ceramic Art - What, Why, How?
P4001	-	Pegs to Progress
M1015	-	Making Shoes

PUBLIC SERVICE

Work which benefits groups of people. Teachers, police, firemen, government workers, military, and public utilities.

AV MATERIALS

Kit H-458 (4-9)	-	Public Service Workers
Kit 402	-	Municipal Law Enforcement
Kit 411	-	Public Utilities
Kit 413	-	Public Service
Film 2	-	A Career in Education
Film 5	-	A Career in Law Enforcement

AIU

I2046	-	Is a Career in Government for You?
P4004	-	The Police Film

TOPIC	GRADE LEVEL	FIRM NAME	CONTACT PERSON	PHONE
AAA	10 - 12	AAA	Rod Stadfield, West Penn Club	361-3300
Advertising Agency	11 - 12	P. Feldman & Kahn	(Jack) Jocques Kahn	261-2883
Aeronautics	--------	Pgh. Institute of Aeronautics	James Fisher	462-9011
Airlines (All Phases)	9 - 12	Pittsburgh Institute of Aeronautics	Mr. Fisher (Sandra Kerr)	462-9011
Animals	K - 12	West Penn Humane Society	William R. Renn, Supt.	321-4625
Animals	K - 12	Animal Rescue League	Mr. "Al" Panagakas	661-6452
Armed Services	K - 12	Army	Sgt. J. Camarata	881-4666
Artist	K - 12 K - 12	Pitt Studios Art World	Mr. Clarkson Mr. Hessler	261-0460 835-4121 941-5636
Bakery	K - 12	Dunkin Donut	Bob Jordon	881-9819 884-5136 (HOME)
Barber	K - 12	Pgh. Barber School 421 East Ohio Street	Mr. Frank Quinio	321-5457
Beautician	K - 12	Pgh. Beauty Academy	John Stanko	471-0270

TOPIC	GRADE LEVEL	FIRM NAME	CONTACT PERSON	PHONE
Bookkeepping, Secretarial, Accounting, Manager Fashions	4 - 12 (Special presentation 4-6)	Duff's Business School	Mr. Kalik	261-4520
Broadcasting	7 - 12	Andrew's Institute of Radio and TV	Joann Allen	731-2000
Carpet Installing, Interior Design	K - 12	Carpet Installer School	Mr. John Lesko	362-5947
Civil Construction, Cosmetology, Data Process., Auto/Diesel Mechanics, Electronics, Marketing, Aircraft Mechanics	9 - 12	Steel Valley Technical School	Mr. Butella, Guidance Coordinator	461-8373
Computer	8 - 12	Computer Sys. Institute	Mr. Aber or Mr. Yorta	261-6110
Consumer Affairs	K - 12	Alliance for Consumer Protection	Jim Getzie	241-8778
Customer Relations	K - 12	Al Schwartz Pontiac	Mel Harden, General Mgr.	655-3388
County Police	K - 12	Allegheny County Police	Sgt. James Miles	355-4216
Detective	K - 12	County Detective	Mr. Ariman	653-0108 (HOME)
Fashion Design, Clothing Construction	K - 12	Fashion Design 110 9th Street	Emma Yorkich	261-3543

Fashion Merchandising, Secretary, Receptionist	12	Powers Modeling	Jan Baime	261-5522
Fast Food Service	K - 12	MacDonald's	Ed Morrison, Bill Pauley	366-6500
FBI	10 - 12	FBI	Mr. Stephan	471-2000
Finishing & Modeling, Marketing & Fashion, Bosses Pet Peeves	Girls Only 6 - 12	Wheeler School	Mrs. Brett	261-6848
Finishing & Modeling	7 - 12	Powers Modeling	Jan Baime	261-5522
Floral Arranging	K - 12	Pgh. School of Floral Design	Patrick McKinney, Director of Personnel	355-0684
Food Broker	K - 12	Don Irwin Food Brokers	Phil Necomb	821-6140
Funeral Director	7 - 12	Pgh. School of Nursery Science	Dr. Emory James	682-0334
Health Industry	K - 12	European Health Spa	Leslie Adams, Asst. Mgr.	882-8855
Jeweler	K - 12	Balfour Comp	Mr. Wiley	885-0808 (Office) 884-5793 (HOME)
Language	K - 12	Berlitz School of Lang.	Eugene Marogta	471-0900

TOPIC	GRADE LEVEL	FIRM NAME	CONTACT PERSON	PHONE
Loans	K - 12	Associates	Larry Raud	341-5201
Medical Secretary Asst., Asst., Receptionist, Dental Assistant, Technician	4 - 12	Median School	Betty Mauer	391-7021
Newspaper	5 - 12	Pgh. Press & Gazette	Helen Kiser	263-1422
Optician	K - 12	Jones--Joyce Kapp, Inc.	James Jones, (Avail. Fri's.	892-2070, 243-7766
Pharmacist	K - 12 K - 12	Baldwin-Court Pharm. Herbert's Leader Drug	Sal Gaetano Mr. Goldberg	892-2433
Pilot, Stewardess, Mechanic, Reservationist, Customer Service	7 - 12	Allegheny Airlines	Mrs. Nancy Vaughan	264-8900, X7097
Pilot	K - 12	Private	David Winans	653-0573
Postal Service	K - 12	U.S. Post Office	Mr. Feacon, Film and Magic Show	644-4712
Railroad	K - 12	Norfolk & Western		261-5388
Realtor	K - 12	Hammil-Quinlan	Mrs. Dunn -- Broker	833-7700
Recording Industry	K - 12 (Tours)	Artick Records	Ralph Cominio	731-6060

Recreation	K - 12	South Community YMCA	Jay Newby	655-4515
Sales	K - 12	J. C. Keppie	Mr. Corver	281-7696 (Off.) 882-3242 (HOME)
Secret Service	K - 12	Secret Service	Special Agent in Charge, Anthony Carmona	644-3384
Security Police	K - 12	Union Security Service	Mr. W. Cervenak	276-1200
Sports Baseball Football Tennis	 K - 12 K - 12 K - 12	 Pgh. Pirates Pgh. Steelers Pgh. Triangles	 Bill Guilfile, P.R. Joe Gordon, P.R. Dan McGibney, John Felman	 323-1000 323-1200 782-0500
Symphony	K - 6 Concert Series	Heinz Hall	Mrs. Lincoln Maazel Youth Symphony	281-5185
Security Guard	K - 12	Globe Security	Mrs. Lard	231-2320
Stewardess	12	Wilma Boyd	Anne Antonelli	391-2584
Technical Opportunity	K - 12	Gateway Technical	Wayne Smith, Director	281-4111
Television	7 - 12	WIIC	By Williams	321-8700
Upholstering & Other Trades	9 - 12	Culligan Water	David Solan	923-2212

TOPIC	GRADE LEVEL	FIRM NAME	CONTACT PERSON	PHONE
Ministery of all Faiths	4 - 12	Pastoral Association	Rose Payne	661-1239

46

To: Dr. N. J. Staresinic

From: Andrew S. Romito

Topic: BHQ Teacher Evaluation

Date: May 22, 1975

Attached you will find the Faculty Evaluation of BHQ Careers. What conclusions we draw from an evaluation of this sort is more than likely based on the reader himself. With that in mind, I have drawn the following tentative conclusions:

1. Better than 50 percent of our teachers responded to the evaluation survey which we feel is a good return at this point of project progress.

2. The elementary schools on the whole, have given us fine cooperation and show a great amount of increase in activities during the second year.

3. The elementary school teachers need to familiarize themselves further with Heights Resource Center. The center is still relatively unfamiliar to many. We would suggest an in-service day be devoted to the elementary teachers for a conducted tour of the Center so they will become more comfortable using it.

4. At present, we have already involved 1/3 of the teachers in the use of the career cards. This is rather amazing in that only late last year the five limited grade levels were distributed.

5. We have picked up 24 teachers who are willing to act as resource people. This is, I feel, a heartening number when you consider volunteering to be a resource person means extra work with little renumeration for each of these individuals.

6. The teachers who answered the survey seemed particularly willing to avail themselves of a career consultant file; this would seem to indicate their receptiveness and dedication to career education.

7. The weakest areas still seem to be the Intermediate and Senior High. Therefore, next year we will concentrate more fully on these two areas.

In general, career education awareness has increased in the last two years. We see that awareness in the world outside the school and it is absolutely essential that we begin to better mirror it in the schools.

Enclosures

rmm

TOTAL SCHOOL DISTRICT - 161 Responses out of 307 Teachers

HIGHLANDS SCHOOL DISTRICT

FACULTY EVALUATION
of
BHQ CAREERS

Grade _____ Date _____ Building _____

	YES	NO
1. Have you implemented Career Education in your classroom?	122	39
What was your manner of implementation? (Role play, Hands-On Experience, Field Trip, Resource Person, Career Resource Center, Other) Please underline proper area.		
2. Have you made use of the card base file? (i.e., Career Education Resource Cards.) (If not, why?) _____	55	101
3. When you receive the resource cards, will you be willing to use them?	69	5
4. Have you visited the CRC (Career Resource Center)?	66	97
5. Have you used the center for any reason this year?	57	100
6. Would you consider using the CRC in the future?	125	20
7. Would you be willing to participate in a quarterly feedback procedure?	85	56
8. Will you make use of a career consultant file? (List of resource people who will be willing to make classroom career presentations.)	124	12
9. Are you willing to participate as a resource person in our career education project?	24	104

If so, in what area?

_____ Area

_____ Name

10. Suggestions and/or constructive criticism.

TOTAL SECONDARY

HIGHLANDS SCHOOL DISTRICT

FACULTY EVALUATION
of
BHQ CAREERS

Grade _____ Date _____ Building _____

	YES	NO
1. Have you implemented Career Education in your classroom?	58	32
What was your manner of implementation? (Role play, Hands-On Experience, Field Trip, Resource Person, Career Resource Center, Other) Please underline proper area.		
2. Have you made use of the card base file? (i.e., Career Education Resource Cards.) (If not, why?) _____	27	60
3. When you receive the resource cards, will you be willing to use them?	15	3
4. Have you visited the CRC (Career Resource Center)?	50	38
5. Have you used the center for any reason this year?	34	52
6. Would you consider using the CRC in the future?	70	16
7. Would you be willing to participate in a quarterly feedback procedure?	44	30
8. Will you make use of a career consultant file? (List of resource people who will be willing to make classroom career presentations.)	67	11
9. Are you willing to participate as a resource person in our career education project?	17	57

If so, in what area?

_____ Area

_____ Name

10. Suggestions and/or constructive criticism.

(26 - 66)

HIGHLANDS SCHOOL DISTRICT

FACULTY EVALUATION
of
BHQ CAREERS

Grade 11-12 Date _____ Building Senior High

	YES	NO
1. Have you implemented Career Education in your classroom?	16	10
What was your manner of implementation? (Role play, Hands-On Experience, Field Trip, Resource Person, Career Resource Center, Other) Please underline proper area. See Enclosure.		
2. Have you made use of the card base file? (i.e., Career Education Resource Cards.) (If not, why?) _____	7	16
3. When you receive the resource cards, will you be willing to use them? (DOES NOT APPLY TO SECONDARY TEACHERS. ALL SECONDARY TEACHERS DID RECEIVE CARDS.)		
4. Have you visited the CRC (Career Resource Center)?	13	11
5. Have you used the center for any reason this year?	10	14
6. Would you consider using the CRC in the future?	15	6
7. Would you be willing to participate in a quarterly feedback procedure?	11	7
8. Will you make use of a career consultant file? (List of resource people who will be willing to make classroom career presentations.)	16	2
9. Are you willing to participate as a resource person in our career education project? See Enclosure.	4	16

If so, in what area?

_____ Area

_____ Name

10. Suggestions and/or constructive criticism. See Enclosure.

(23 - 64)

HIGHLANDS SCHOOL DISTRICT

FACULTY EVALUATION
of
BHQ CAREERS

Grade 9 - 10 Date _____ Building Intermediate

	YES	NO
1. Have you implemented Career Education in your classroom?	17	6
What was your manner of implementation? (Role play, Hands-On Experience, Field Trip, Resource Person, Career Resource Center, Other) Please underline proper area. See Enclosure		
2. Have you made use of the card base file? (i.e., Career Education Resource Cards.) (If not, why?) See Enclosure.	10	13
3. When you receive the resource cards, will you be willing to use them? DOES NOT APPLY TO SECONDARY TEACHERS		
4. Have you visited the CRC (Career Resource Center)?	15	8
5. Have you used the center for any reason this year?	10	13
6. Would you consider using the CRC in the future?	20	3
7. Would you be willing to participate in a quarterly feedback procedure?	10	10
8. Will you make use of a career consultant file? (List of resource people who will be willing to make classroom career presentations.)	16	5
9. Are you willing to participate as a resource person in our career education project? See Enclosure.	4	16

If so, in what area?

_____ _____ Area

_____ Name

10. Suggestions and/or constructive criticism.

1. Manner of implementation:

Role play	4
Hands on experience	4
Field trip	4
Resource person	2
Career RC	4

2. If not, why?
   1. My field is not elaborately covered (music)
   2. Poor choice
   3. Not in teaching position
   4. course taught lends itself to career ed.

9.

Area	Name
Instrumental Music	Joseph Aliquo
Business/D. E.	Mrs. Malobicky
Coach/ironworker/forestry	Mr. Dick Tudor
Creative writing/journalism or teaching	Donna Jean Domin

10.
   1. In the material I've seen music is only sparsely covered and not any where near adequate.
   2. I think we are spending too much money on this program.
   3. I submitted various ideas to BHQ - so I imagine some of my ideas were on your file.
   4. I think Intermediate teachers do as much with careers as any bldg. therefore BIE day should be centered around them. Careers are centered too much around the month of February. Sept. and Oct. would be much better when students are not as busy and then hope the interest is carried on the remainder of the year.
   5. As Career Ed. Coordinator in Intermediate I feel card file system extremely good - more teachers should utilize the card file & CRC.
   6. I am a reading teacher - those who are paid to do BHQ should. Every time a new curriculum is written I'm told to implement it into my program. I'll be forced to cancel out my own curriculum.
   7. Unable to use under present course offering ISCS.
   8. Provided good source for our civics unit on careers.

41 - 52

HIGHLANDS SCHOOL DISTRICT

FACULTY EVALUATION
of
BHC CAREERS

Grade 7 - 8 Date 4-23-75 Building Jr. High

	YES	NO
1. Have you implemented Career Education in your classroom?	25	16
What was your manner of implementation? (Role play, Hands-On Experience, Field Trip, Resource Person, Career Resource Center, Other) Please underline proper area. see enclosure		
2. Have you made use of the card base file? (i. e. Career Education Resource Cards.) (If not, why?) see enclosure	10	31
3. When you receive the resource cards, will you be willing to use them? DOES NOT APPLY TO SECONDARY TEACHERS, i.e., ALL SECONDARY TEACHERS RECEIVED CARDS		
4. Have you visited the CRC (Career Resource Center)?	22	19
5. Have you used the center for any reason this year?	14	23
6. Would you consider using the CRC in the future?	35	6
7. Would you be willing to participate in a quarterly feed back procedure?	23	13
8. Will you make use of a career consultant file? (list of resource people who will be willing to make classroom career presentations.)	35	4
9. Are you willing to participate as a resource person in our career education project? see enclosure	9	25

If so, in what area.

_____ Area

_____ Name

10. Suggestions and/or constructive criticism.

see enclosure

TOTAL ELEMENTARY

Fawn	5-13	
Prospect	4-6	
1st ward	11-12	49
2nd ward	6-6	
3rd ward	6-7	
Riverview	5-6	
Heights	9-13	
Fairmount	9-9	
Birdville	14-20	
Wood St.	6-8	

HIGHLANDS SCHOOL DISTRICT

FACULTY EVALUATION
of
BHC CAREERS

Grade K - 6 Date _____ Building Elementary

	YES	NO
1. Have you implemented Career Education in your classroom?	66	7
What was your manner of implementation? (Role play, Hands-On Experience, Field Trip, Resource Person, Career Resource Center, Other) Please underline proper area. see enclosure		
2. Have you made use of the card base file? (i. e. Career Education Resource Cards.) (If not, why?) See enclosure	28	41
3. When you receive the resource cards, will you be willing to use them?	54	2
4. Have you visited the CRC (Career Resource Center)?	16	59
5. Have you used the center for any reason this year?	23	48
6. Would you consider using the CRC in the future?	55	4
7. Would you be willing to participate in a quarterly feed back procedure?	41	26
8. Will you make use of a career consultant file? (list of resource people who will be willing to make classroom career presentations.)	57	1
9. Are you willing to participate as a resource person in our career education project?	7	47

If so, in what area. see enclosure

_____ Area

_____ Name

10. Suggestions and/or constructive criticism. see enclosure

1. Manner of implementation:

Role play	5
Hands-on-experience	5
Field Trip	2
Resource Person	2
Career Resource C.	8
Movies	2
Discussion	1

2. (If not, why?)
   1. Not extensive
   2. None that apply
   3. No time
   4. Overlapping
   5. Busy time
   6. Limited - not aware of Possibilities

9.

Area	Name
Art/Ed. - Career	M. Iarkin
Library	M. Derbaum
Math	D. Henderson
Music	R. Bickel
Reading/English	S. Sh. Sherman
Science	R. Allen
Science	M. Harenski
Special Education	S. Triber
Speech	N. Mamula

10. Suggestions and/or constructive criticism:
    1. CRC isn't open until 10:00 - would like to expose all students.
    2. Would like list of projects underway to eliminate repetition.
    3. Missed workshop in the fall, might be why many teachers not aware of full potential of career ed.
    4. Hard to use because of drug ed., consumer ed., environmental ed.

Comments - elementary

1. Manner of implementation:

Role play	34
Hands - on	12
field trip	9
Resource person	15
Career Resource	21
film	3
Discussion	4
Reports	2

2. 1. above K. level
   2. have not received them
   3. did not know where they were
   4. do not have file
   5. none for 4th grade
   6. unfamiliar
   7. not yet available
   8. none available
   9. we don't have one;
   10. wasn't sure of procedure
   11. cards not ready for 2 gr.
   12. suggestions unrealistic
   13. never received cards
   14. didn't know they were available

9.

Area	Name
3 rd grade	Nancy Myford
helping teachers write cards	M. Lokar
elementary teacher	W. H. Clark
waitress, salesclerk, special education	Carole Harrigan
music, organist	Deborah Dobrzynski
furniture industry	Dennis C. Wray
art	Mary Kay Miller

10. 1. Making use of CRC can be extremely useful;
    2. visited the CRC and plan to use SRA kit;
    3. Career ed. at elementary level is out of place;
    4. As a group students exhibited no interest in Career Ed.
    5. Has the CRC been open for visitation for teachers when they could get there?
    6. Have a wrap-up discussion every week on Career Ed. at a specific time;
    7. Have any parent who could take a child for half day to observe parent job and report back to class;
    8. this material should be only to make children aware of different careers;
    9. I feel career ed. should be strictly incidental in elementary ed;
    10. why burden yound minds too soon! Jr. High is soon enough;
    11. I really feel teachers will use card file system more and more as time goes on;
    12. Many feel they are being pressured. Are not using career ed.
    13. I would suggest not using a quarterly feedback as it would be impractical to conduct C. E. during each quarterly period.
    14. A workshop on methods of integrating career ed. into curriculum would be helpful as unit teaching;
    15. think program could be integrated very well if class size is small;
    16. don't favor quarterly feedback - possibility I wouldn't use it each quarter;
    17. at present time think we should concentrate on programs we already have.

TO: Jane Robertson Fortney, Project Director
FROM: Robert J. Powers, District Coordinator, Quaker Valley School District
RE: BHQ Career Education Project, 4th Quarter Report
DATE: June 30, 1975

The Quaker Valley School District has seen many positive actions in career education taking place in its classrooms this year. Eleven teachers in grades K, 1, 2, 5, 6, 8, 9, and 10 have been working on rewriting curriculum to adapt it to career education this year. (See attachment #1) There has been about 50 of these units developed this year.

The teachers in grades 3, 4, 7, 11, and 12 that worked in curriculum last year have tried their new curriculum in the classroom this year. The teachers have reported back that the students like the idea of more information in their subjects on career education. In turn, the job these teachers have done has started an interest in career education in the other teachers.

The career resource cards developed last year in the project are now available to all the teachers in the district. The teachers are able to use the cards for activities, resources, and ideas relating to a career. Most teachers have reported success in using the cards. New cards have been developed by the teachers working the project.

The career resource center has met with great success this year. The center has been used by both individual students and teachers. Some teachers at the Senior High School have had their classes research different careers in the center for classroom reports. The career aides in the centers have reported a steady increase in the use of the center throughout the year.

In October of this year, the District held a workshop on career education for all of the teachers. The teachers met in groups to discuss how they could best use the idea of career education in their classrooms. All the

QUARTERLY REPORT (continued)

equipment in the project was viewed by the staff and questions were answered in its use in the classroom.

Because of the BHQ Project, there is now a lot of positive interest in career education in the Quaker Valley School District. The outlook for success in the classroom with both students and teachers for next year is very good.

Communication Grade 5

DEVELOPMENTAL SHEET FOR CAREER EDUCATION

Original lesson goals and objectives:

To realize the importance of the communication system.

To understand the various types of communication throughout the world.

To understand why man developed ways of communicating.

To trace the development of communication from cave man days.

Career concept lesson goals and objectives:

To understand the various careers found within the communications field.

To expand the body of facts which includes the qualifications needed for the following jobs:

Telephone Operator	Telegraph Operator
TV Announcer	Secretary
Newspaper Reporter	Radio Broadcaster
Telephone Repairman	Radio/TV Repairman
TV Cameraman	Journalist

Curriculum changes made or additional resources, learning excursions, and/or in-class application phase.

Resource Speakers: Telephone Operator
Newspaper Reporter
Repairman

Field Trips: Radio or TV station; newspaper; Telegraph Office

Films: A Chairy Tale
Getting the News
Television on Line By Line
Are You Listening?
The Alphabet Conspiracy
Beyond All Barriers
Cities in Crisis-Communication
Debt to the Past-Language and Communications
A Fable
Letter to Grandmother
Magic of Communicating
The Mailman

Daily Newspaper for current items as well as an example of communication.

Radio and TV in the classroom, if possible.

Rationale -

The students should gain a better understanding of the how and why of communications.

The students should be able to compare cultures whose methods of communicating are different from ours, e.g., The Canary Islands.

The students should be able to apply communication skills learned throughout this unit in all phases of their lives.

The students should be able to communicate their own ideas more clearly.

Behavioral Objectives -

To identify means and methods of communication.

To evaluate the best and clearest methods of communicating.

To determine the effect of propaganda if presented through a well, thought-out communication regardless of the media used to get it to the public.

To be able to separate fact from fiction in communications.

To be able to use words which will best express what they are trying to say.

To decide how much affect the news media has on public opinion.

Materials -

Resource Books: How Communication Helps Us
The True Book of Communication
Red Light Says Stop
Body Talk
I Want to be a Telephone Operator
Four-Ring Three
Television Works Like This
What Makes Television Work
All About Radio and Television
First Book of Television
Television as a Profession
Television Broadcasting
Television Production and Direction
Radio and Television
Radio as a Profession

Study Prints: Technological Communication
Written Communication
Primitive Communication

SEE OTHER SIDE

Records: Federal Communication
Telephone

Bell Telephone Company will bring headsets to the school, and an instructor will come to explain telephone courtesy and how to use the telephone correctly.

Films: (See curriculum additions)

Resource Speakers: (See curriculum additions)

Presentation -

Since there is no chapter in any of the students' texts specifically dealing with communication, I have adapted the chapter on speaking, listening, and writing from the language book. An outline will be provided that will cover all the topics to be discussed. Worksheets will also be made, and the students will be responsible for locating the answers. Some of these answers will be given in class discussions; others must be researched.

Naturally, there will be a lot of communicating done during this unit! I will involve as many types of communication as possible: writing; speaking; sign language; braille; video-tape; body language; etc. The main thrust will be the video-taping. Each child will prepare a news item that they will report on. After corrections have been made, a stage will be prepared, and the children will give their reports.

There will be two viewings of the video-tape: one, the reporter will see himself and do his own evaluation without anyone else present; two, the entire class will view the tape, and make constructive suggestions to the reporter.

Application Phase -

The students will be better able to communicate with other people.

The students will be more attuned to false reporting, exaggerating, "padding" of the various media when attempting to communicate their ideas.

The students will have an expanded body of facts which will enable them to express themselves in a manner that is clear to any who they come in contact with.

The students will realize that there are many ways of communicating, and that a physical handicap does not necessarily mean that a person is incapable of communication.

The students will be more aware of career choices in this and related fields.

Evaluation -

Evaluation will be done on a two-part basis: The student will evaluate himself; The class will evaluate the individual student.

There will be a written evaluation done by the teacher that will be given to each "reporter." Suggestions, as well as criticisms, will be offered.

BODY OF THE REPORT

Problem Area

Despite the increased emphasis on education in this Country, little has been accomplished, until recently, to properly define its work-relevance, as well as enhance career perspectives. A number of theories can be advanced to explain this apparent educational failure: (1) the continuous existence of wars in the past 30 years--producing a significant distracton from career concerns, both by students and their teachers; (2) inability of teachers to articulate career-identification programs because of their lack of specific training and experience in fields other than teaching; (3) insufficient guidance counseling (which has become college-placement oriented) because of large school populations and difficulty in defining individual talents; (4) specialization of teachers prohibits overall evaluation of student potentialities and encourages a "protective" attitude about the integrity of their curriculum specialties; (5) a general public confusion on career identification caused by the technological revolution, particularly in certain ethnic and socio-economically handicapped cultures; (6) procrastination on career identification, by perhaps half the student population who intend to attend college; (7) the growing national leisure-consciousness and glorification as opposed to "the work ethic" as well as a tendency to "grudingly compensate those who provide essentials."

Regardless of the relative contributions by these and other influences, it is generally agreed that we have done a rather minimal job of preparing students for enlightened career selection. We are particularly deficient in the long-term development of career awareness. It is believed that satisfying career selection should evolve from a long-term personal consideration of a number of options, weighted by considered evaluation of personal abilities and likes/dislikes . . . balanced by an appreciation of the intermediate goals necessary to fulfill a career aspiration.

The specific problems for which we seek enlightment and ultimate solutions are:

1. to improve the work-relevance of school curricula to prepare all students to earn a living;

2. to improve career interrelationships among public education, private schools, manpower agencies and the general public;

3. to broaden the awareness, aspirations, and opportunities for career preparation by helping students in Grades K-14 match opportunities with their desires and capabilities;

4. to better identify the socio-economic handicaps earlier, and minimize their interference with career aspirations;

5. to take maximum advantage of the cooperative three-district interrelationships (and associated private schools) via exchange of materials, curricula and experiences; and

6. to make the BHQ Program an exemplary one for the other school districts.

Goals and Objectives of the Project

1. Through exposure to classroom instruction, field trips, and a variety of resources (human, print, non-print) and experiences, students will realize the practically unlimited possibilities for continuing self-development, both in the world of work and in self-awareness.

   As a result of the curricula, students will be provided with decision-making skills necessary for making appropriate choices from career alternatives available to them.

2. Given appropriate resources, the "BHQ" Careers Centers will develop a realistic process by which students, parents, and community will have increased utilization of information and resources vital to the decision-making points of the career development process.

3. As a result of in-service programs, faculty will develop positive attitudes toward career education as demonstrated in adaptation/adoption of career units and resources in their curricula.

4. Through early identification of handicapped and disadvantaged students, appropriate career counseling and other action as needed will be provided to minimize impediments to career choices.

5. Through personal contact and an intensive PR program, business, industry, parents, and the community will actively participate in the career program either as recipients or donors of services.

6. Through contacts in committees and continual communication, the "BHQ" Careers resource materials and curriculum models will be made available to all non-public, non-profit schools in the districts.

7. As a result of liaison with local business, industry, vo-tech. schools, community colleges, and other manpower agencies, their creative participation will be encouraged.

8. Through availability of resources in off-hours and special courses, provide a continuing career education program for grades 13, 14, and beyond.

9. Establish an exemplary program which will serve as a model for career education programs throughout the County of Allegheny and the Commonwealth of Pennsylvania.

STATE AND PROJECT NUMBER: Pennsylvania, V361093

TITLE OF PROJECT: BHQ Career Education

PROJECT DIRECTOR: Jane H. Robertson
Allegheny Intermediate Unit
Two Allegheny Center, Suite 1300
Pittsburgh, PA 15212

APPLICANT ORGANIZATION: Allegheny Intermediate Unit

DURATION: 3 years July 1, 1973, to June 30, 1976

DESCRIPTION OF PROGRAM:

Administrative Structure
The Project Director is on a full-time basis in the Intermediate Unit. In the three districts a part-time coordinator is assigned to the project. Key teachers, fifteen (15) in each district will be extensively in-serviced the first portion of the project and they in turn will in-service, in district, their grade level teams.

Program Design
The program is designed with the following variables of the three districts considered:

1. The Baldwin-Whitehall School District is composed of two boroughs and one township. The area is suburban in nature, with a total population of approximately 46,000. The district is served by 15 public schools and three private schools, with an overall student enrollment of 11,219. There are 474 identified disadvantaged in the district with .5% black and .2% non-caucasians.
2. The Highlands School District, includes the townships of Fawn and Harrison and the boroughs of Tarentum and Brackenridge. The area is suburban in character, but includes heavy industrialization along the Allegheny River. The total population is 32,647. The district is served by 13 public schools and 2 private schools, with an overall student enrollment of 6,523. Identified disadvantaged are approximately 800 or 13.6% — ethnic distribution includes 143 total non-caucasians, 130 black, and 13 orientals.
3. The Quaker Valley School District is composed of nine boroughs and two townships. The area is suburban in character, with a total population of 15,632. The district is served by six public schools and two private schools, with an overall enrollment of 2,563. There are 157 families that are identified disadvantaged; of these 21 are below poverty level. Ethnic composition is extremely mixed including 9% black enrollment or approximately 235 students.

The first year curriculum development and adaptation will take place on five grade levels; 3, 6, 7, 10, and 12.

The second year, the interim grades will become involved and also the post-graduate component will be developed for 13 and 14.

The third year, all teachers and all students will be included and the ongoing piloting revision and in-service effort will continue.

III. Program Components

A. Occupational Orientation -- In order to accomplish true occupational orientation, K-14, all facets must be considered:

1. A total intensive orientation of administration, staff, and teachers.
2. Collection of materials for dissemination to classrooms and true curriculum integration so all students are reached.
3. Establishment of Career Resource Centers with counseling made available to daytime students and post graduates and the community in off-hours.
4. Retraining and reassessment of guidance roles in career education.

B. Cooperative Education -- All three districts currently have some programs available to students, but all three hope to expand the availability of occupational training to meet the needs of more students.

C. Intensive Job Entry Skill Training — Curriculum advisors from business and industry will assist in revisions and suggestions to get all students better prepared for job entry.

Guidance counselors will assist with mini-workshops on resume preparation, interview techniques, and application forms. Small local contracts will be made with Vo-Tech and Jr. Colleges to broaden the scope of the program and broaden the variety offered 9-14.

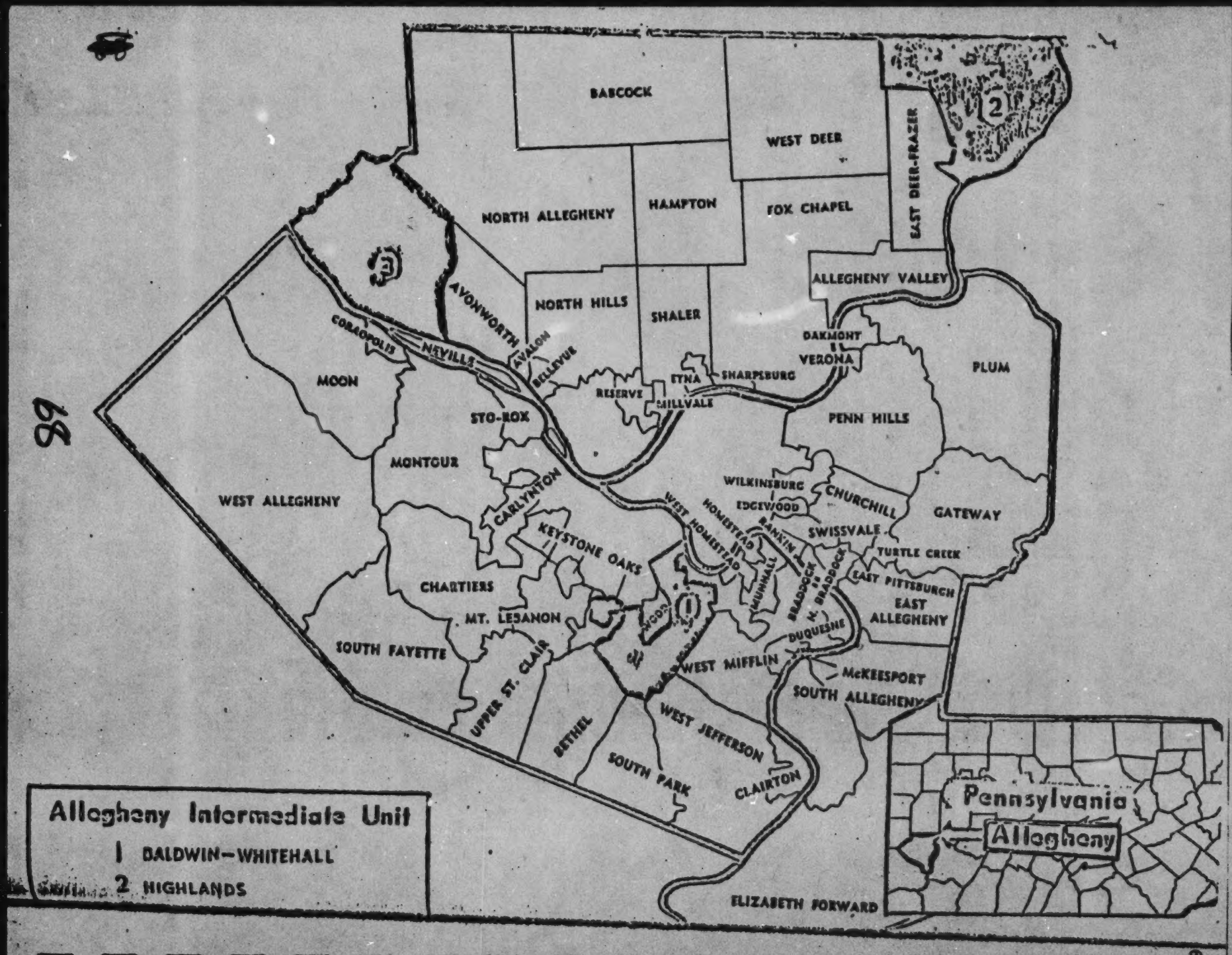
All students will be given opportunities to closely examine actual work situations and report on them. At present, each of the three districts feeds into one of the county vo-techs on a half-day basis; however, we are striving to establish more vo-tech courses at the high schools to help supplement the need.

D. Occupational Guidance, Counseling, and Placement — Career education now gives guidance new direction and an area of real accountability. Beginning with the kindergarten level, children will be encouraged and given the opportunity to consider how they feel about what they are doing or experiencing as a prelude to decision making in the future. Guidance components and values will be integrated into the curriculum. Now, counselors will act as resource people to classroom teachers to assist students to evaluate who they are, where they are going, and how to best get there. The evaluation design includes assessment of this accomplishment.

School counselors and other guidance personnel will assist teachers in planning curriculum and aiding pupils who need and will benefit from experiences outside the normal educational environment.

With a true developmental knowledge of himself, his values and interests, he can now make a real decision as to direction. Once again, guidance is the department to supply information and methods for reaching his set goals. We should be able to provide placement for all students, regardless if they decide upon job entry, tech schools, junior colleges, or four-year degree institutions. It is a guidance concept to be taught all others -- each individual has value and worth and is deserving of assistance in finding his proper place.

Parents will be involved at every step of the way so that they may plan a supportive role as their youngsters make their decisions. Information will be provided to parents as necessary to enable them to do this.


BABCOCK
WEST DEER
EAST DEER-FRAZER
NORTH ALLEGHENY
HAMPTON
FOX CHAPEL
ALLEGHENY VALLEY
NORTH HILLS
SHALER
AVONWORTH
CORAOPOLIS
NEVILLE
AVALON
BELLEVUE
DAKMONT
VERONA
ETNA
SHARPSBURG
RESERVE
MILLVALE
MOON
PLUM
STO-ROX
PENN HILLS
MONTOUR
WILKINSBURG
CHURCHILL
EDGEWOOD
GATEWAY
WEST ALLEGHENY
CARLYNTON
WEST HOMESTEAD
HOMESTEAD
RANKIN
SWISSVALE
TURTLE CREEK
KEYSTONE OAKS
MUNHALL
BRADDOCK
N. BRADDOCK
EAST PITTSBURGH
EAST ALLEGHENY
CHARTIERS
MT. LEBANON
DUQUESNE
SOUTH FAYETTE
UPPER ST. CLAIR
WEST MIFFLIN
McKEESPORT
SOUTH ALLEGHENY
BETHEL
WEST JEFFERSON
SOUTH PARK
CLAIRTON
ELIZABETH FORWARD
Pennsylvania
Allegheny
Allegheny Intermediate Unit
1 BALDWIN—WHITEHALL
2 HIGHLANDS

SCHOOLS AND LOCATIONS

Allegheny Intermediate Unit #3
Two Allegheny Center, Suite 1300
Pittsburgh, Pennsylvania 15212

The Allegheny Intermediate Unit is a service agency for the 46 participating school districts in Allegheny County, excluding the City of Pittsburgh. This unit was created by an Act of the Pennsylvania Legislature, to replace the previous County Schools Administration. Among the services provided to the participating school districts are the efforts of more than 1000 teachers working throughout the area served, in functions such as vocational education and guidance.

The County of Allegheny, with a population of about 1.6 million, consists of about 12,000 practicing teachers in the 129 local municipalities.

This project, "BHQ Careers,": is in operation in three local school districts -- Baldwin-Whitehall, Highlands, and Quaker Valley. Their relative locations within Allegheny County are indicated on the maps which follow; their student/staff statistics also are included in the accompanying tabulations. These three school districts serve a combined total population of 94,067 and were selected for this exemplary project because of their high level of interest in "careers" curriculum orientation and best liklihood of developing programs which will be truly exemplary to other districts.

Baldwin-Whitehall
scale: 1"= 1000'

Baldwin-Whitehall School District
4900 Curry Road
Pittsburgh, Pennsylvania 15236
(412) 884-6300

The district is composed of two boroughs (Baldwin and Whitehall) and one township (Baldwin). The area is suburban in nature, with a total population of 45,788. The district is served by 14 public schools and three private schools, with an overall student enrollment of 10,963.

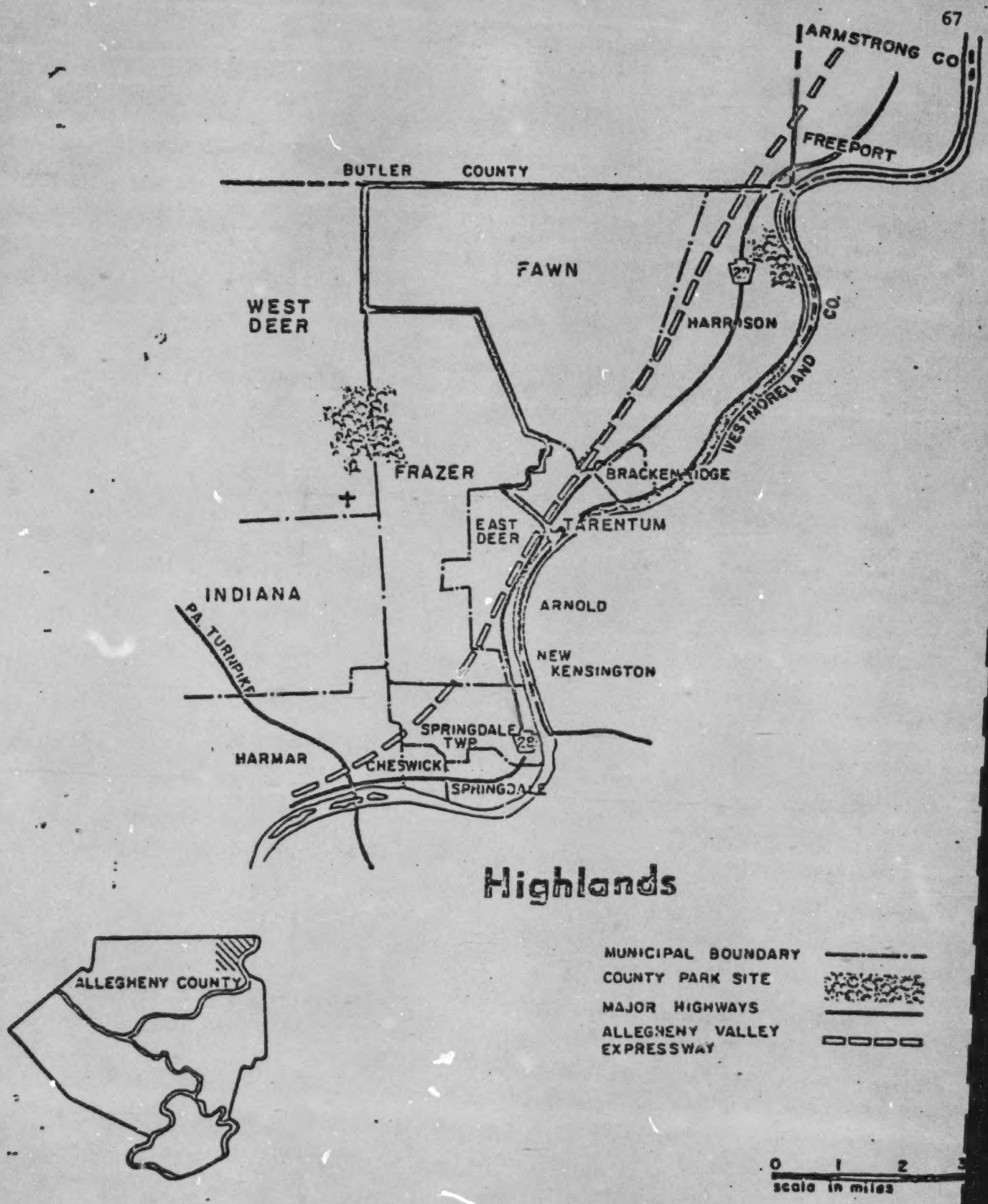
SCHOOLS STATISTICS

SCHOOL	STUDENTS BY GRADES													STAFF		
	K	1	2	3	4	5	6	7	8	9	10	11	12	Teachers	Other	Coun.
Lafferty	75													2.5		
McAnnulty				524										21.5		
McGibney				505										19.0		
Oakleaf				303										16.0		
Overlook				406										14.5		
Provost				189										8.0		
Rolling Hills				353										14.5		
Sickman				560										25.0		
Skyline				473										19.0		
Spitler				312										14.0		
The Highlands				367										14.5		
Union				136										7.0		
Elementary Totals			4,203											175.5	35	0
Paynter Mid.								880						47.5		2
Wallace Int.										927				53.0		2
Whitehall Jr.									1231					66.0		3
Baldwin												2175		126.0	1	5
Jr.-Sr. High Totals												5213		292.5	1	12
Grand Totals												9416		468	36	12

Non-public Schools in District:

Two, Grades 1-8; One, Grades 1-12 1547 Students (14.1% of Total)

Total of Public and Non-public Enrollment 10,963


ARMSTRONG CO
FREEPORT
BUTLER COUNTY
FAWN
WEST DEER
HARRISON
WESTMORELAND CO.
FRAZER
BRACKENRIDGE
TARENTUM
EAST DEER
INDIANA
ARNOLD
PA. TURNPIKE
NEW KENSINGTON
SPRINGDALE TWP.
HARMAR
CHESWICK
SPRINGDALE
ALLEGHENY COUNTY
MUNICIPAL BOUNDARY
COUNTY PARK SITE
MAJOR HIGHWAYS
ALLEGHENY VALLEY EXPRESSWAY
0 1 2 3
scale in miles

Highlands

Highlands School District
Ninth & Corbet Street
Tarentum, Pennsylvania 15084
(412) 224-2339

The district, about 20 miles north of the City of Pittsburgh, includes the Townships of Fawn and Harrison and the Boroughs of Tarentum and Brackenridge, a total of about 24 square miles in area. The area is suburban in character but includes heavy industrialization along the Allegheny River. The total population is 32,647. The district is served by 13 public and 2 private schools, with an overall student enrollment of 6,523.*

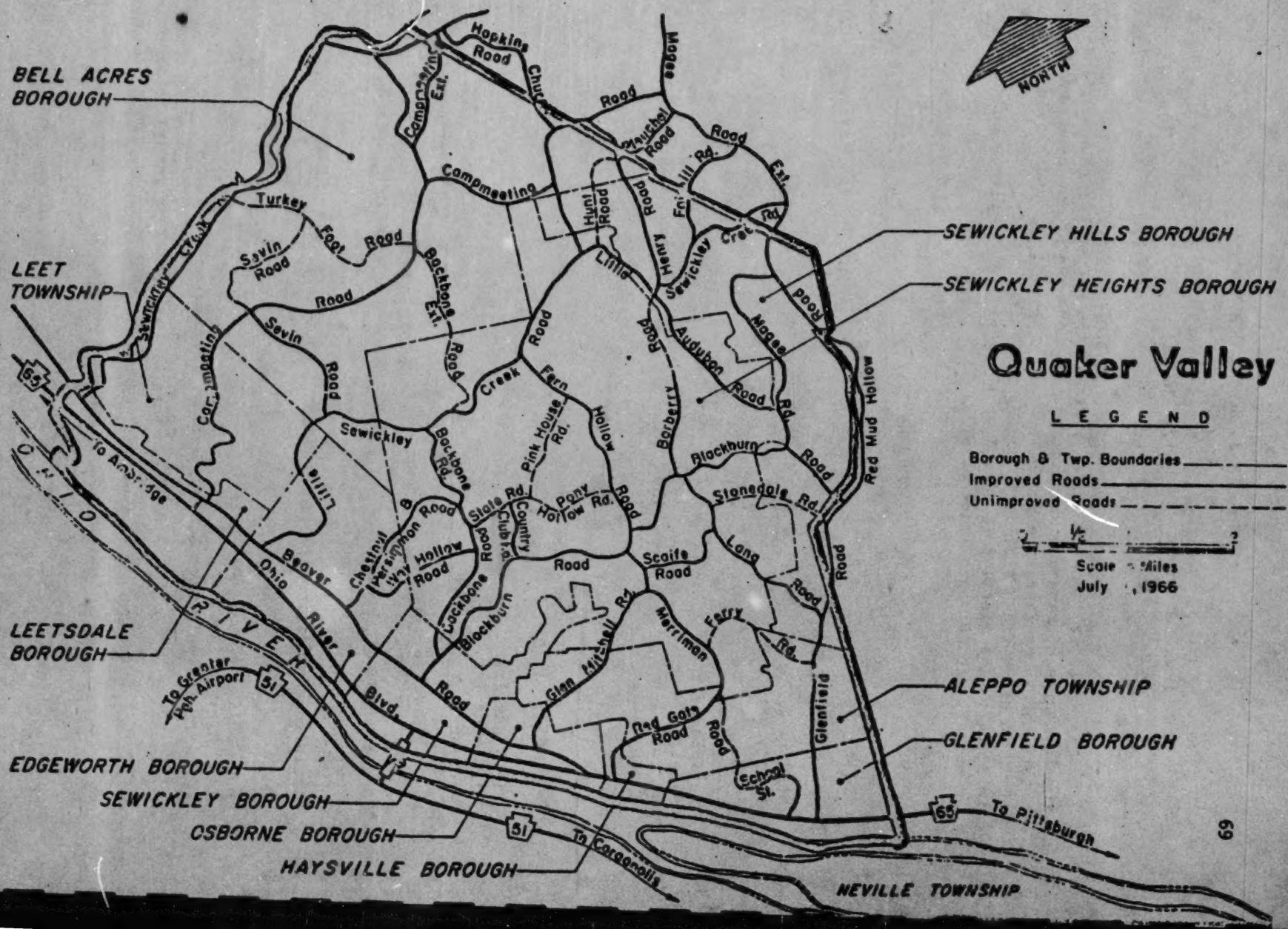
SCHOOLS STATISTICS

SCHOOL	STUDENTS BY GRADES													STAFF		
	K	1	2	3	4	5	6	7	8	9	10	11	12	Teachers	Other	Coun.
Birdville				545										26	2	
Fairmount				234										14	2	
Fawn				410										19	2	
First Ward				381										16	2	
Natrona Heights				332										16	2	
Prospect				196										7	1	
Riverview				189										8	3	
Second Ward				168										6	2	
Third Ward				213										7	2	
Wood Street				230										10	3	
*Elementary Totals														129	21	2
Highlands Jr.								969						52	1	2
Highlands Int.									1130					63	1	2
Highlands Sr.												1025		62	2	3
*Jr.-Sr. High Totals														177	4	7
**Grand Totals												6126*		306	25	9

*Includes an additional 75 in learning disabilities and special education.

Non-public Schools in District

Blessed Sacrament, 1-8	295
St. Joseph's High School, 9-12	123
TOTAL	418 (6.4% of Total)


Quaker Valley
LEGEND
Borough & Twp. Boundaries
Improved Roads
Unimproved Roads
Scale Miles
July , 1966
NORTH
BELL ACRES BOROUGH
LEET TOWNSHIP
LEETSDALE BOROUGH
EDGEWORTH BOROUGH
SEWICKLEY BOROUGH
OSBORNE BOROUGH
HAYSVILLE BOROUGH
SEWICKLEY HILLS BOROUGH
SEWICKLEY HEIGHTS BOROUGH
ALEPPO TOWNSHIP
GLENFIELD BOROUGH
NEVILLE TOWNSHIP
OHIO RIVER
To Ambridge
To Greater Pgh. Airport
To Coraopolis
To Pittsburgh
Hopkins Road
Campmeeting Ext.
Campmeeting
Turkey Foot Road
Savin Road
Sewickley Creek
Backbone Ext.
Backbone Rd.
Sewickley
Little
Beaver
Ohio River Blvd.
Chestnut
Hersman Road
Hay Hollow Road
State Rd.
Country Club Rd.
Pink House Rd.
Pony Hollow Rd.
Fern Hollow Road
Creek Road
Blackburn
Glen Mitchell Rd.
Merrimon
Scaife Road
Barberry
Audubon Road
Henry Road
Sewickley Cret.
Moore Road
Red Mud Hollow
Stonedale Rd.
Lang Road
Ferry Rd.
Red Gate Road
School St.
Glenfield
Church Road
Hunt Road
Fair Hill Rd.
Ext.
Rd.
65
51

74

69

Quaker Valley School District
221 Beaver Road
Sewickley, Pennsylvania 15143
(412) 741-6000

The district is composed of nine boroughs (Leetsdale, Edgeworth, Sewickley, Osborne, Haysville, Glenfield, Sewickley Hills, Sewickley Heights and Bell Areas) and two townships (Leet and Aleppo). The area is suburban in character, with a total population of 15,632. The district is served by 6 public schools and two private schools, with an overall enrollment of 3444.

SCHOOLS STATISTICS

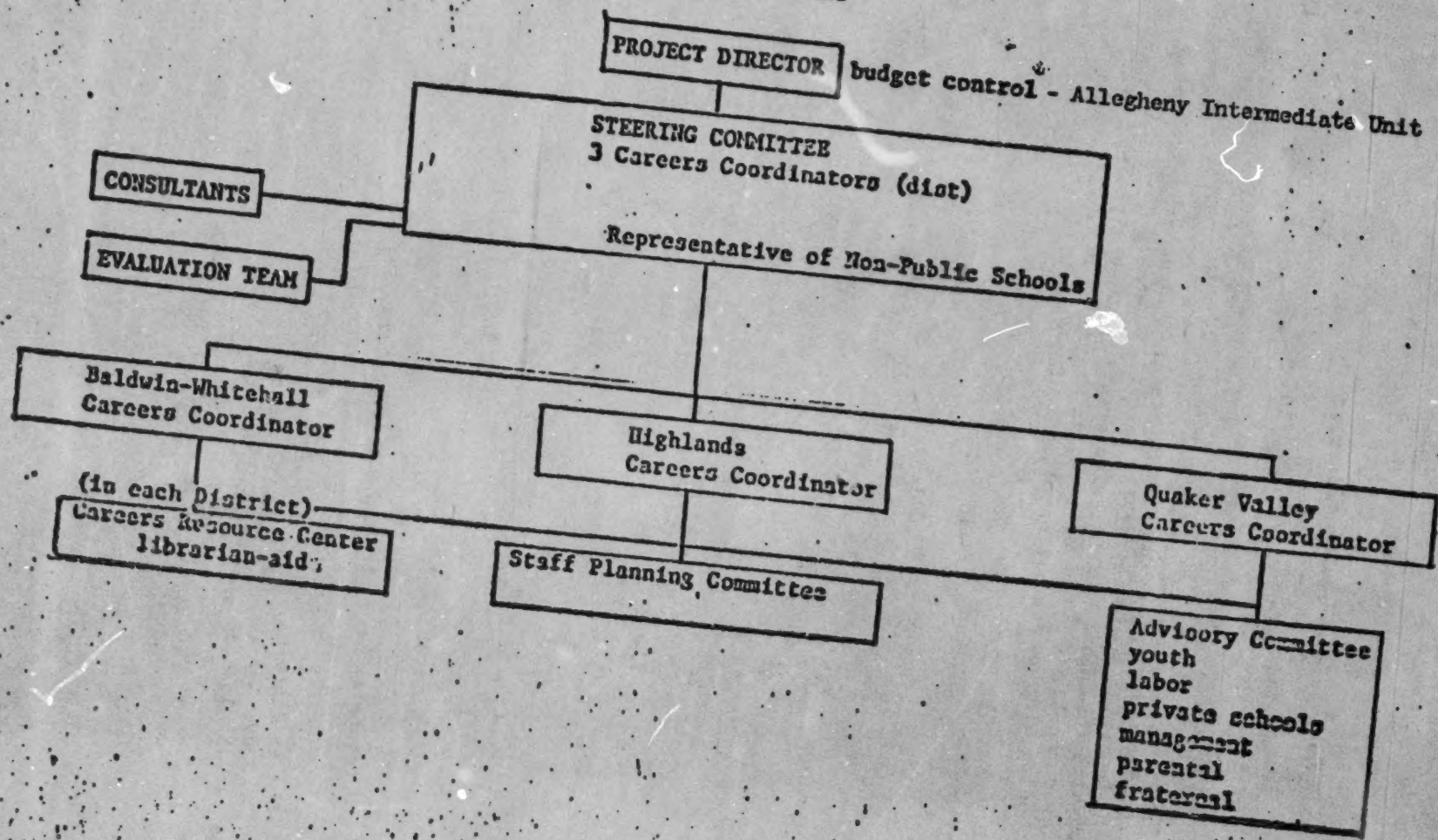
SCHOOL	STUDENTS BY GRADES													STAFF		
	K	1	2	3	4	5	6	7	8	9	10	11	12	Teachers	Other	Conn.
Edgeworth				284										10	2	
Fair Oaks				227										9	2	
Leetsdale				226										10	2	
Sewickley				470										20	5	
*Elementary Totals				1207										59	11	0
Quaker Valley Jr. High									693					39	4	2
Quaker Valley Sr. High												696		44	3	2
*Jr.-Sr. High Totals												1389		83	7	4
*Grand Totals												2596		142	18	4

(1) Including 10 teachers shared throughout elementary.

Non-public Schools in District
Sewickley Academy, K-12 583 students
St. James Parochial School, 1-8 265 students

TOTAL 848 (24.6% of Total)

ORGANIZATIONAL CHART



RESULTS AND ACCOMPLISHMENTS OF THE PROJECT

Sample packets of our completed teacher resource card files for grade levels 3, 6, 7, 10, and 12 accompany this report.

We also feel that the United States Office of Education Report very explicitly identifies our strengths and weaknesses. We have, therefore, reproduced the report and included it in the following pages.

USOE PERFORMANCE REVIEW REPORT
Allegheny Intermediate Unit #3
Suite 1300, Two Allegheny Center
Pittsburgh, Pennsylvania 15212
USOE Grant No. OEG-0-73-5276
Project No. V361054
January 17, 1974 - April 8, 1975

Title of Project: "BHQ" Career Education

Dates of Performance Review: April 8, 9, 10, 1975

I. Introduction

The purposes of the performance review are to: (1) assess project administrative and management accomplishments, (2) ascertain extent of achievement of goals and objectives for the review period, (3) identify project strengths and weaknesses and make recommendations for improvement.

II. Overall Observations

A. The project has progressed satisfactorily for the period reviewed. Several distinctive accomplishments, as listed below, serve to demonstrate progress achieved.

1. The career education staff and administration have accomplished the recommendations as delineated by last year's review team, within budget limitations.

2. Objectives as delineated for year II have been accomplished at varying levels.

3. Development, production and dissemination of a teacher based resource card file. All teachers in all disciplines have files now available to them. Further development is in process to expand and augment the card file for teachers at all grade levels.

4. All districts have had total in-service orientation, grades K-12, including administration and counseling personnel. All have participated in follow-up workshops pertaining specifically to elementary and secondary career objective activities. Further breakdown to departments and grade levels are being scheduled on a continuum basis.

5. The career education staff have provided services of orientation in-service and consultation that has resulted in the implementation of career education programs in an additional 25 districts serviced by the Allegheny Intermediate Unit.

6. This project has been instrumental in the presentation and adaptation of career education in neighboring Beaver County.

7. Dissemination of curriculum materials has been made at production cost to all 46 of the Allegheny County Districts.

8. It was noted in several schools that there was great flexibility in the scheduling of students to permit the incorporation of work experience or other educational experiences (career orientation and awareness) at other institutions or the business community.

B. The reduction of the project's operating budget from $148,958.00 to $83,007.00 in February 1974 was originally reviewed having a devastating effect. A reassessment was made for year II to reduce certain activities affecting some of the project's objectives. There was a reduction in funds for career education materials and funds to pay teachers for the development of the career education teacher based card files. Grade level coordinators are now being paid with many teachers developing card files on their own time without remuneration. The Director, career education staff and the administration should be commended for their resourcefulness in continuing to meet the major objectives within the funding limitation.

C. Career Education Planning Committees have been established in all three participating districts. Certain team members had the opportunity of attending a meeting of the Highlands Planning Committee. Members of the Committee are very enthusiastic and active and assist the career education staff and administration in accomplishing the objectives of career education. The Committee assists in bridging the gap between parents, schools, students, and the business community in implementing career education concepts into the curriculum at all levels of education. The Committee has been most helpful in the identification of resource persons for utilization by teachers.

III. Overall Recommendations

A. Many of the career resource materials are housed in library facilities. This arrangement was viewed as unsatisfactory for the proper storage and utilization of the resource materials.

Recommendation #1

That the career resource centers be housed in separate facilities to insure full teacher/student utilization.

Recommendation #2

That a wider range and greater depth of career material be procured in areas where student interests are high.

Recommendation #3

That additional delivery systems be developed to better assist students with information processing. These systems would meet the individual needs of each student as he progresses through the decision making process of making a career choice.

B. Difficulty has been experienced when investigating career clusters in the present system.

Recommendation #1

Should develop a cross index of occupational and career materials that would assist teachers and students in the exploration of career clusters.

C. Some major activities and accomplishments in one of the school districts are not being adapted in the other two districts.

Recommendation #1

Increased efforts should be made to have a greater cross-fertilization of successful career education activities within the three BHQ districts.

D. One major objective of the project is the involvement of non-public, non-profit schools in career education. It was observed that little progress has been made toward the accomplishment of this objectives.

Recommendation #1

That efforts be increased this year and year III to involve non-public, non-profit schools in the BHQ project.

IV. Elementary School Activities

A. The performance review team visited all elementary schools participating in the project. The objectives at the elementary level seem to be directed more toward self and career awareness. A variety of modes are used to deliver this particular concept at the elementary level. Classroom activities move to accomplish the objectives by the emphasis on role playing, field trips, parent visitation, use of the BHQ developed card file activities and resource materials.

B. The team conferred with administrative personnel and teachers. It was agreed that there was a definite need to provide more career activities to infuse career education concepts.

A "Split Time" principal travels among three elementary schools. This contraint admittedly puts a strain on the desired continuity of administrative support for the total efforts of career education activities. However, the administration did express their support for teacher involvement in career education activities. This support has apparently created an atmosphere conducive to innovative work activity among the individual staff members.

C. The objectives at the elementary level are being met through the following activities: Grade 1-6 teachers are using the BHQ developed Card File System to stimulate in class activities. The teachers visited at the elementary level stated that the card system is being used and considered it an important part of the career education awareness process. The resource materials available through the BHQ established resource centers were observed being used in the classrooms visited. Other activities observed were role playing and the use of a new ITV Series "Bread and Butterflys." The "Bread and Butterflys" series has been recommended by the various State Departments of Education across the country to strengthen the guidance function in the elementary and junior high classrooms. The teachers indicated that several field trips were taken to nearby facilities. The reduction of funds in the total school system has restrained field trip activity.

D. All the teachers visited approved of their involvement in the career education workshop that was held to generate career education materials (card files). Each teacher said this was the major entry level activity that started them thinking systematically about career education.

E. Counselors are serving multiple schools at the elementary level which difuses their efforts.

<u>Recommendation #1</u>

That counselors, administrators and teachers assess the specific role and responsibility of the counselor as it relates to career education. Plans should be jointly developed to redirect the counselors efforts to achieving career education concepts.

V. Junior High School

The Quaker Valley Junior High School was visited by one member of the review team since the schedule of the other members did not include visitation to other junior high schools.

A. It was noted that since the implementation of the "BHQ Project" that there was a greater utilization of career materials by the guidance counselors. This material was being utilized to provide a more flexible schedule for each student. Of particular interest was the great visibility of career education materials. The project has provided the needed support to assist the guidance department in taking a stronger role in assisting students to make career choices.

B. The CRC is being utilized in all aspects of the project. The junior high students were using the material in many classes. Classes were being held in the CRC to allow students to interact with the material as the need arises. The CRC was sharing space in the school library.

C. A significant addition to the second year program at the junior high school was the involvement of the total teaching staff in utilizing career education materials. The career card files had been expanded to include 7-9 grades. This development was viewed as a positive step for the development of career awareness in all aspects of the junior high school program.

D. The project staff, administrators and counselors investigated the relationship between the junior high program and the requirements to enter the local area vocational technical school. This investigation brought forth the fact that the junior high program needed modification to allow students the flexibility for a number of career choices at the secondary and post-secondary level.

E. The junior high school program provided for community involvement by allowing the local parochial school to participate in the practical arts program one period, twice a week. Parents and community agencies were also involved through orientation by the project staff, counselors, teachers and the student body.

F. Students are receiving hands-on experience at the junior high school in such areas as food service and hospital care. They are encouraged to visit local trade, technical and professional education programs which offers the students the opportunity to assess their career choice.

Recommendation #1

That the BHQ Project provide more "hands-on" experience. Explore the feasibility of incorporating the "World of Construction" and the "World of Manufacturing" in the curriculum.

Recommendation #2

That a plan be developed to provide students with exploring experiences to enable the student to make more realistic career decisions.

VI. Secondary School Activities

The overall philosophy of the project to integrate career education into the regular curriculum was quite evident at the secondary level. The use of the teacher based resource card files was observed in various subject fields. Conversations with secondary subject matter teachers indicated a breakthrough by the project staff. This is exemplified through the integration of career education concepts into their curriculum. Overcoming the secondary staff reluctance is cited as a major accomplishment of the project. The project infusion strategy would insure continuation of the career education activities after federal funds are exhausted.

A. A formalized career awareness program has been developed at the 9th and 10th grade levels. The program integrates the awareness program with social studies programs for all 9th and 10th graders in one school district. Approximately seven days of each reporting period in every social studies classroom is devoted to career research and career education classroom activities. The program is closely tied in with counseling and testing to provide students and parents with as much guidance as possible in making course selections and planning an educational program leading to a successful career.

B. The Baldwin-Whitehall School District has expanded its vocational curriculum by negotiating an agreement with a private aeronautical school. The school will train qualified 11th and 12th grade students in aviation mechanics. The program will begin September 1975. Students will spend one-half day receiving academic training in their home school and the other half in the aeronautical program. Similar agreements may be consumated with private schools for training in automotive repair.

C. Co-op and/or work experience programs are, or are becoming, operational in all the BHQ districts. These programs are providing paid employment experiences for in-school youth. Providing the necessary academic support for the students appears to be presenting some problems.

D. Senior Career Elective Program: The senior program at Baldwin-Whithall High School provides an opportunity for seniors to spend two to four weeks receiving an on-the-job orientation and work experience in a career of interest to them. The students spend the entire school day at their work experience location. They must have a faculty sponsor who monitors the student's progress through weekly meetings. The progress of the student is also ascertained by the employer sponsor who submits a weekly report. The orientation is an unpaid experience and students are involved in a wide variety of careers including medicine, law enforcement, film making, farming, etc.

E. At least two of the BHQ schools are using career consultants and/or fairs to provide accurate, current and relevant information relative to clusters of occupations. The career resource centers in each of the BHQ secondary schools also foster occupational information aspects of the secondary program.

F. The second year of the project provided for corrolation between the career materials and the classroom subject matter. Teachers in all areas were utilizing the materials and infusing career education concepts into the curriculum.

Recommendation #1

That efforts be continued and expanded to involve more secondary subject matter instructors in utilizing the teacher based career resource cards.

VII. Post Secondary Articulation

A. The post-secondary component of the BHQ Project has been developed during the second year of operation. This phase has been primarily developed around career conferences and visitations with local colleges, universities, industrial firms, and other organizations in the Pittsburgh area. Programs are being planned with the colleges and universities to allow students to attend college prep courses during both the summer and the academic year. Noted by the team was the ground work established with Penn State University, of Pittsburgh, and the Community College. Also noted was the cooperative development of courses at the Pittsburgh Institute of Aeronautics for secondary and post-secondary students.

B. The guidance program has provided additional service at the post-secondary level with follow-up information and counseling service for graduates. Also, job information was provided at the post-secondary level.

C. The CRC's have been opened for an evening program to assist post-secondary people in career planning and decision making. At this time it was noted that the utilization has been low and this aspect of the program has been cut back.

D. During the second year of operation, the BHQ staff taught career education courses for Allegheny Community College and the University of Pittsburgh. These courses were involved with the training of pre-service and in-service teachers.

VIII. Guidance and Counseling

Guidance and counseling activities are interwoven throughout the entire project. The BHQ activities are indirectly infusing change in the guidance and counseling programs in the three districts involved in the project. Specifically, counselors are being made aware, through students and teachers, of a broader role in helping students with the career planning process.

A. In the elementary component most of the counseling is directed toward self and career awareness activities. The lack of certified counselors at the elementary level necessitates the use of teachers for the counseling role. The activities mainly involve the use of parents and others to describe their careers. Career oriented bulletin boards and displays were evident in nearly all elementary schools visited.

B. Guidance and counseling at the junior and senior high school levels involves primarily career orientation and exploration. Significant activities include:

1. periods of time devoted to career research;

2. greater emphasis of student interest, aptitude and ability evaluations relative to the career planning process;

3. opportunities for explorations in a diversity of careers--non-skilled through professional;

4. career fairs and consultants; and,

5. flexible scheduling to provide students with the opportunity for outside (the school) career explorations.

C. The counselor's role is certainly much more direct at the junior high and secondary level. However, the BHQ Project has shifted the counselor's role from one of a decision maker to that of a career planning manager. In this new role, the counselor is being asked to provide significant amounts of information to students, including personal, potential and career options, in guiding the individual through the career planning process. Most counselors in the BHQ Project schools see the emerging role as being more compatible with their perceived role.

D. Counseling and guidance activities in placement and post-secondary articulation do not seem to be as direct as the in-school components. While placement is relatively high in all the BHQ schools, the accomplishment was not the result of direct counselor intervention. Since placement in post-secondary institutions is well about 50 percent in two of the BHQ districts, one might question the efficacy of a more structured placement effort. Note should be made of the emerging attempts of the BHQ counselors to articulate their counseling efforts with post-secondary institutions.

E. While one overall project objective was to provide special career counseling for handicapped and disadvantaged students, the team saw little evidence of progress toward the objective. The Allgeheny Intermediate Unit does have certain responsibilities in the process, but the involvement was not delineated.

Recommendation #1

Counselor involvement in the BHQ Project while somewhat indirect seems to be much greater than project reports indicate. It is recommended that counselors be given greater visibility and a definite role in achieving the overall objectives of the project.

Recommendation #2

That increased efforts be made to get additional counselors to participate in the in-service activities associated with the BHQ Project.

Recommendation #3

That the BHQ staff reevaluate the career counseling for disadvantaged and handicapped objective. Activities should be developed toward accomplishing the objective during the third year.

IX. In-Service Training - Administrators and Teachers

A. The following activities demonstrate the efforts made by the career education staff to continue staff development at all levels:

1. All teachers in the BHQ Project area attended a one day in-service presentation that was conducted by the career education staff members.

2. Seventy-five professional staff members in the three districts, identified by grade level, were given a four-day intensive workshop relating to the implementation of career education.

3. General and specific area workshops are continually ongoing in the three districts (example: counselor role adjustment workshops).

4. New teachers in the card development workshops were paid $6.00 per hour to use their particular grade level expertise to develop the card file activities.

B. Student and teacher outcomes as a result of in-service education.

1. An additional change in both teachers and counselors has been observed as evidenced by pre-post test application.

2. New materials are now available to all districts as a result of the work done by teachers on the card file system during in-service.

3. Students now have an opportunity to become more aware of careers in all lifestyle areas. This awareness and specific information at the secondary level allows the student a better chance to either "opt" for continuing education or work after exit from the secondary school system.

X. Administration

A. The administration has demonstrated support for the project from its inception. No problems have been encountered relative to administrative procedures in implementing the project. Local and Intermediate Unit administration are commended for their continued cooperation and support in implementing career education in the three districts.

B. A conference was held with Dr. Harold Oyer, Executive Director of the Allegheny Intermediate Unit #3, and members of his staff regarding plans for the continuation of career education in all schools at all educational levels after the project is completed.

Recommendation #1

That a plan be developed to continue the infusion of career education at all educational levels after the project ends June 30, 1976. Additional objectives should be established and an assessment made of available staff, resources, and a determination of the availability of funds to accomplish the expanded objectives.

XI. Evaluation

The third party evaluator for year I on the project was ESI of Waco, Texas. ESI was unwilling to comply with new federal guidelines that had been established by USOE, which necessitated a rebidding process.

The contract for the third party evaluator was approved by USOE and awarded to ERANDA of West Chester, Pennsylvania.

The design has been set and the pre-test phase has been accomplished. The post-test phase is to be carried out in May.

It is the unanimous concensus of the team that satisfactory progress is being made toward the achievement of the project objectives as evidenced by the findings that are delineated above, and therefore, recommend that the project be continued for the third year.

ATTACHMENT - A

Performance Review Participants

I. Performance Review Team

Mr. Earl J. Dodrill, Senior Program Officer, VTE
Region III, Philadelphia, PA
Dr. Clarence Dittenhafer, Research Associate, Pennsylvania
Department of Education, Harrisburg, PA
Mr. Ray Miller, Project Director, West Virginia,
Region III, Parkersburg, West Virginia
Mr. Thomas O'Brien, Research Assistant Professor, Vocational
Education Department, University of Pgh., Pittsburgh, PA

II. Administrative Staff

Dr. Harold Oyer, Executive Director, Allegheny Intermediate Unit
Dr. James B. Schmunk, Director, Instructional Support Services

III. Career Education Administrative Staff

Mrs. Jane Robertson Fortney, Project Director
Mr. Harlan Nelson, Project Coordinator, Baldwin-Whitehall School District
Mr. Andrew Romito, Project Coordinator, Highlands School District
Mr. Robert Powers, Project Coordinator, Quaker Valley School District

V. Administrators and Staffs of Schools Visited

A. Baldwin-Whitehall School District

Dr. Donald W. Strang, Superintendent
Mr. Paul Delo, Supervisor of Pupil Personnel Services
Dr. Robert V. Flynn, Supervisor of Curriculum and Instruction
Mr. James F. Bruni, Principal, Baldwin High School
Mr. Warren Frabizio, Vice-Principal of Baldwin High School
Mr. Gene Schmucker, Dean of Students & Coordinator, Senior Elective Program
Mrs. Barbara Cingel, Counselor, Baldwin High School
Mr. Frank Blankenbuehler, Chairman, Career Ed. Steering Committee, Baldwin High School
Mrs. Millie Matich, Aide in charge of Career Resource Center, Baldwin High School
Mrs. Marilyn Remp, 3rd Grade Teacher in charge of Careers Program on Computers, McGibney Elementary School

V. Administrators and Staffs of Schools Visited (Continued)

A. (Continued)

Mrs. Alice Mervos, 1st Grade Teacher, McGibney Elementary School
Dr. James Shumaker, Principal, Wallace Intermediate High School
Mr. Tony Mazzocco, Counselor, Wallace Intermediate
Mr. Robert Bayer, Social Studies Chairman, Wallace Intermediate
Mrs. Harried Hinkel, Librarian, Wallace Intermediate
Mr. Charles Eaton, Principal, The Highlands Elementary School
Mrs. Marjorie Rea, 6th Grade teacher, The Highlands Elementary School
Mrs. Norinne Ruehl, 3rd Grade Teacher, The Highlands Elementary School
Joyce Petrow, Senior High School Student
Rene Buckley, Senior High School Student
Billie Schrecker, Senior High School Student

B. Highlands School District

Mr. Bache, Principal, Highlands Intermediate School
Mr. Davidek, Vocational Technical Counselor, Highlands Intermediate
Mrs. Hamilton, Counselor, Highlands Intermediate
Mr. Harrs, Highlands Intermediate, Counselor
Mr. Chick, Career Resource Center, Highlands Intermediate
Mrs. Myford, Elementary Coordinator, Highlands Intermediate
Dr. Staresinic, Superintendent, Highlands School District
Mr. C. Schmitt, Director, Public Relations/Federal Funds, First Ward
Mr. E. Howell, Director, Elementary Education, First Ward
Mr. Paul Urik, Director, Secondary Education, First Ward
Mr. Kocon, Principal, First Ward
Mrs. Krumemaker, 3rd Grade Teacher, First Ward
Mr. Clark, 6th Grade Teacher, First Ward
Mr. Guzzi, Vocational Technical Director, Highlands Sr. High School
Mr. Gill, Job Placement Coordinator, Sr. High School
Mr. Nitowski, Principal, Sr. High School
Mrs. Kuhn, Coordinator, Sr. High School
Mrs. Weidl, Career Resource Center, Sr. High School
Mr. Pisani, Principal, Riverview School
Mr. Thickey, 6th Grade Teacher, Riverview School
Miss Dziuban, 5th Grade Teacher, Riverview School
Mrs. Cincala, 1st Grade Teacher, Riverview School

C. Quaker Valley School District

Mr. Raymond J. Bergman, Principal, Quaker Valley Jr. High
Mr. Robert J. Andrews, Guidance, Quaker Valley Jr. High
Miss Jacqueline M. Woznicki, Guidance, Jr. High
Mrs. Helen Foster, Homemaking, 7, 9, Jr. High
Mrs. Antoinette Alphonse, Librarian, Jr. High
Mr. Everett A. Niemela, Industrial Arts, 7, 9, Jr. High
Mr. Stanley Simantiras, General Business, 9, Jr. High
Miss Debbie Roadie, Project Aid, Jr. High
Mr. Gabriel Ruzzini, Guidance, Quaker Valley Sr. High
Miss Marie Torrito, Guidance, Senior High
Mr. Roy W. Horne, Industrial Arts, Senior High
Mrs. Barbara Smith, Project Aid, Senior High
Mr. Byron A. Harriger, 6th Grade Teacher, Quaker Valley Elementary School
Mrs. Pamela Wytarowicz, Project Secretary, Quaker Valley School District

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS FOR THE FUTURE

The fund cut, which is even greater for the third year than it has been for the second, is going to place the project in a considerable bind. We will now be forced to rely even more on the momentum and enthusiasm we established during the first two years. Once again, we plan to pay only building coordinators at contracted flat fee rather than at the previous $6.00 hourly rate.

The refinement of the project during the third and final year will include the following concentrated efforts.

1. That each and every student be given an opportunity for at least a 3-day exploration into their chosen career field.

2. Counselor conferences and a survey of all students will obtain percentages of students graduating with at least one saleable skill.

3. That all three districts have established some plan and definition of responsibility for placement by the end of the third year.

4. A monthly feedback system through the building coordinators be established for an accurate record of what's happening and where.

5. A realistic identification be made by counselors at the junior high level of handicapped or disadvantaged for referral to specialized vocational guidance in order to minimize impediments to career choice.

6. Availability of counselors to vo-tech adult evening programs.

7. Support and in-service component in continuum to increase classroom participation.

8. Greater support enlistment through buisness and industry.

9. Building of the already present human resource files.

10, A constant effort to close the gap between secondary and post-secondary institutions.

ADDENDUM

ADDENDUM

ALLEGHENY INTERMEDIATE UNIT

HAROLD E. OYER · EXECUTIVE DIRECTOR
Suite 1300 · Two Allegheny Center · Pittsburgh, PA 15212
(Area Code 412) 321-5700

May 1, 1975

Mrs. Jane Fortney
Director, BHQ Project
Allegheny Intermediate Unit
Pittsburgh, PA 15212

Dear Mrs. Fortney:

Again, many thanks for your contribution to the Career Education Program, presented at the I.U. Convention on April 29, 1975. I believe the program had a significant effect on the school directors in attendance and that this will result in rapid growth and acceleration of career education programs in Allegheny County. You will have had an important role in bringing this about.

Sincerely

James F. Jordan
Assistant Executive Director

fwf

ATTACHMENT B

CAREER GIANTS

A Bicentennial Unit

Especially prepared for the
I. M. C.
B. H. Q. Career Education
by
Nancee A. Nyga Ch.
Judy Morgan
Judith Harvey

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I Overview

II List of Career Giants

III Materials Recommended for Purchase

IV List of Recommendations

V Sample Lesson Plans

OVERVIEW

Career decision is not the goal, but to use the Career Giants that America has produced to give inspiration to the student to aspire to try something different. The Career Giants that have been listed are those not included in the regular curriculum thus giving the ITS the opportunity to enrich the curriculum through unusual careers of famous persons not normally emphasized in the classroom.

The sample plans we have included describe various creative activities that you may find helpful to expand your career programs.

In addition, a sample plan is included to emphasize colonial careers for a Bicentennial unit. Career Giants may be spotlighted when appropriate for the different crafts.

SOME NAMES TO BEGIN WITH ON THE SUBJECT OF CAREER GIANTS

A. Industry

1. Andrew Carneige
2. Henry Ford
3. H.J. Heinz
4. P. DuPont

B. Arts

1. Walt Disney
2. Stephen Foster
3. Frank L. Wright
4. Grandma Moses
5. Benjamin West

C. Literature

1. Laura Wilder
2. Dr. Seuss
3. William Shakespeare
4. Noah Webster
5. Henry McCloskey

D. Athletics

1. Jim Thorpe
2. Joe Louis
3. Billie Jean King
4. Arnold Palmer
5. Babe Ruth

E. Craftsmen

1. Ethan Allen
2. Paul Revere
3. McClintock
4. Winchester

LIST OF MATERIALS

ATTACHMENT B

This is a list of materials needed for each elementary building for the teaching of the three sample units. These are written into the program and any I.M.C. department using these units will need these materials.

1. Approximately four rolls of slide film per building to take slides of the various progressions as these units develop. These slide sets then can be reused in the building or other elementary buildings at future dates.
2. A central place, such as the department headed by Mae Peat, to send these films to be processed.
3. A fund of twenty dollars needs to be set aside and possibly held by Mae Peat for the I.M.C. to use for the express purpose of purchasing horseradish root. This is an expensive product and the responsibility of financing this should not be automatically placed upop the I.M.C.
4. Walt Disney Educational Materials Company
   800 Sonora Avenue, Glendale, Ca. 91201

   Reading Adventure Kits AD -2 The Art of Animation $25.95
   AD -6 The Love Bug $25.95

5 SVE - Society for Visual Education
   1345 Diversey Parkway, Chicago, Illinois 60614

   Focus On America - The Northeast Region filmstrips and records
   J250-SAR $57.50

6. Xerox Education Publications
   Education Center
   Columbus Ohio 43216

   Chumpy's Word Games No. 231 .45 each 60 copies $27.00
   Using the Dik-she-nehr-ee
   No. 254 (third grade) 30 copies $13.50
   No. 255 (fourth gr.) 30 copies $13.50
   No. 256 (fifth grade) 30 copies $13.50
   No. 257 (sixth grade) 30 copies $13.50

7. Leader-~~Tape~~ Film
   Contact Sheet -

ATTACHMENT B

25

FREE WITH EACH ORDER!

King Features

FREE 30-DAY CLASSROOM TRIAL REQUEST FORM

☐ Please [illegible] in the [illegible]

$37.50 each, plus postage and handling.

____The Comic Book ____The Filmstrip ____The Newspaper
____The Bakery ____Toys & Dolls ____Bubble Gum

☐ Please send____complete 6-unit *People At Work* program(s), $189.50 each, plus postage and handling — along with one FREE Library Storage Case for each program ordered.

I understand I can return all materials in 30 days and owe nothing.

☐ Please send additional information.

PRIN/CAREER ED DIRECTOR 314
MCANNULTY ELEMENTARY SCHOOL
5151 MCANNULTY RD
PITTSBURGH PA 15236

1190

PLEASE SEND INFORMATION ON THESE OTHER KING FEATURES PROGRAMS:
☐ *Comics Reading Library* ☐ *Career Awareness Program* ☐ *Spanish-English Program* ☐ Also send free informative booklet, *Commentary: Comics In The Classroom.*

Canadian Distributor: Edu-Media Limited, P.O. Box 1240, Kitchener, Ontario N2G4H1

ORDER FORM

COMPLETE CAREER AWARENESS PROGRAMS

☐ PLEASE SEND ____ COMPLETE CAREER AWARENESS PROGRAMS $42.50 EACH (Minimum booklet order, $20)
☐ PLEASE SEND THE FOLLOWING COMPONENTS IN THE QUANTITIES INDICATED
☐ PLEASE SEND ADDITIONAL INFORMATION.

QUANTITY*	ITEM
	Booklet Titles
	Health Careers
	Environmental Careers
	Manufacturing Careers
	Transportation Careers
	Communications and Media Careers
	Construction Careers
	Marketing and Distribution Careers
	Agri-Business & And Natural Resources Careers
	Marine Science Careers
	Public Service Careers
	Personal Service Careers
	Hospitality & Recreation Careers
	Fine Arts & Humanities Careers

ALL PRICES PLUS POSTAGE AND HANDLING

QUANTITY*	ITEM
	Consumer & Homemaking Careers
	Business & Office Careers
	Complete Sets of All 15 Titles
	*See prices at left.
	Career Awareness Bingo Game, $5.95 each
	Set of 2 Student Involvement Charts, $2.95 per set
	Teacher's Guides, $2.50 each
	Display Rocks, $8.95 each
	Packages of 25 How-To Study Booklets, $2.95 per package

SEND TO:

Name, Title _____

School _____

Address _____

City, State, Zip _____

Signature _____

Area Code, Telephone _____

☐ Please ship immediately.
☐ Please ship on the following date: _____

1186

100

The following maerials are not needed expressly for the three sample units but are recommended for purchase for the Career Center. These are geared to the needs of the elementary department.

ATTACHMENT B

1. Guidance Associates
   757 Third Ave. New York, New York 10017

   Career Discoveries series

People Who Organize Facts	4 filmstrips	4 10" LPs	4G-301 828	$55.00
People Who Create Art	4 filmstrips	4 10" LPs	4G-301 844	$55.00
People Who Help Others	4 filmstrips	4 10" LPs	4G-301 687	$55.00
People Who Work in Science	4 filmstrips	4 10" LPs	4G-301 588	$55.00
People Who Influence Others	4 filmstrips	4 10" LPs	4G-301 869	$55.00
People Who Make Things	4 filmstrips	4 10" LPs	4G-301 786	$55.00

Discussionguides with each of these units

2. SVE - Society for Visual Education
   1345 Diversey Parkway, Chicago, Illinois 60614
   Community Workers and Helpers Series Sound filmstrips Primary
   Group I $32.50
   Group II $32.50

3. King Features
   Education Division
   Dept. 1186
   235 East 45th Street
   New York, N.Y. 10017

   Complete Career Awareness Program $42.50 each 10 sets $425.00

   Complete 6-unit People At Work program one set $189.50

NOTE: An approximate total of the total materials recommendations from this I.M.C. program study is $1319.00

ATTACHMENT B

RECOMMENDATIONS OTHER THAN FOR MATERIALS - IMC CAREER EDUCATION PROGRAM

1. We recommend that at one of our combined I.MC./Librarian meetings we meet whereever the Career materials are stored. This will give each of us a chance to examine first hand what is available to all of us. This should be done as near to the beginning of the school year as possible.

2. Recommended that all Career education materials for the elementary schools be stored and cataloged from the office of Mae Peat. This also includes consumable materials such as film, along with funds needed to purchase consumable materials as they are needed. (film processing, consumable booklets and foods).

WONDERFUL WORLD OF DISNEY

1. Setting

   A. Castle setting with fantasy, music playing and a sign -- "Welcome to the Wonderful World of Disney"

   B. Learning centers set up around the I.M.C.- Records and books of Disney's works.

      Example-101 Dalmations, Mary Poppins, Peter Pan, Bambi, Pinoochio, Alice In Wonderland, Snow White, Three Pigs, Lady and the Tramp, Robin Hood, 20,000 Leagues Under the Sea, Littlest Outlaw.

2. Background of Famous Person

   A. Use of encyclopedias and biography books to establish background.

3. Accomplishments

   A. Cartooning and Animation

      1. Leading students to the book section on drawing and cartoons.

      2. Producing a linear-visual story by cutting pictures from magazines and placing them in a line so an observer could look at the pictures and understand the story through visuals only.---A linear-visual story could also be made with film and a camera having students make up their own visual story and take photographs.

      3. Making Flip Pictures.

      4. Drawing on film leader using magic markers and showing this on 16 mm projector after each section is spliced.

   B. Films (Nature, full length Cartoons, and Documentaries)

   C. Disneyland and Disneyworld

4. Careers

   A. Cartoonining

   B. Movie Making and jobs relating to movie industry.

5. Speakers and or Films

   A. John Johns-Cartoonist--Contact him at Art Institute of Pittsburgh.

   B. Films can be borrowed from the Intermediate unit.

      1. Nature's Half Acre

      2. Living Desert etc.

   C. Contact parents to show a slide presentation on Disneyland or Disneyworld.

6. Presentation on Famous Works

   A. Dioramas

   B. Plays

7. Materials Needed

   A. Leader film

   B. Kodak film

   C. Art of Animation $25.95

      F/S tape 10 books-Walt Disney Ed. Materials Co.--800 Sonora Ave. Glendale, Ca. 91201

H. J. Heinz--From Horseradish to Ketchup

1. Setting:

   A. A large ketchup bottle cut out of corrugated cardboard with a caption, "How Many of the 57 Varieties do You Know?"

   B. Students bring in labels from the 57 Heinz products and display these on a bulletin board.

   C. Mobiles can be made by the children using the basic food products used in making the 57 foods. Example: ketchup--tomatoes, vinegar, sugar, and spices.

   D. The setting will progress along with the unit as activities develop.

2. Background of Famous Person

   A. Free literature from the H. J. Heinz Company to establish background information.

   B. Pittsburgh Book by Stephen Lorant

3. Accomplishments

   A. An example of the American dream from a humble beginning to that of an industrial giant--Hard work and ingenuity breed success.

      1. Excellent truck farmer

      2. First product--horseradish

         a. Children can make horseradish by grinding a horseradish root.

      3. Development of the 57 varieties

         a. A tasting party can be done with children bringing in the 57 products.

      4. Establishment of Heinz plants in foreign countries.

         a. Students can write to Heinz plants in foreign countries and ask for samples of foreign products and literature. These can be displayed and sampled.

         b. Large map can be made by the students showing where

different products and spices are grown.

c. Window dioramas depicting the beginning farm up to the factory with the pictures getting larger and including more panes as the story progresses.

5. Development of the Heinz Plant from assemply line to complete automation.

A. To show the operation of the assembly line, the children can make soup. Each student can bring in an item to add to the soup and work as an assembly line--carrots, onions, macaroni, parsley, tomatoes, meat, hotplate, large pot. Students can see how long it takes to assemble and cook and then eat the finished product.

4. Careers

A. Truck farming

B. Business Management

C. Sales

D. Jobs related to assembly plant--dietician, chemist, etc.

5. Speakers and Films

A. Film from Heinz--This can be ordered by calling the Heinz Plant and booking the film with them.

6. Presentations on famous works

A. These are listed throughout the outline.

7. Materials Needed

A. Pittsburgh Book by Lorant

B. Film and background materials from Heinz

C. SVE Sound filmstrip kit INDUSTRY IN 20TH CENTURY AMERICA J636-SAR $45.00

SVE
1345 Diversay Parkway
Chicago, Illinois 60614

NOAH WEBSTER THE DIK-SIG-NEHR-EE MAN

1. Setting
   - A. Old fashioned, "Little Red Schoolhouse" setting. Exhibits of old school books , hornbook, spellers, slates, etc.
2. Background of Famous Person
   - A. Read the chapter on Noah Webster in Bailey's 40 American Biographies.
   - B. Encyclopedias or other biography books available.
   - C. Emphasis on Noah Webster as a Bicentennial educator.
3. Accomplishments
   - A. Successful school teacher
   - B. Writer--Wrote a reader to meet the needs of the American school children. Compiled the first American school speller using words the American children would need.
   - C. Revised Johnson's dictionary to eliminate words Americans never used and added words and pronunciations used by the American people.
4. Careers
   - A. Lexicographer--Dictionary maker
   - B. Teacher
   - C. Attorney
   - D. Book publisher
5. Speakers and Films
   - A. Representative from a book publishing company.
6. Presentation on Famous Works
   - A. Making Blue Back Spellers--Each child should choose about 5 American words for his book. Choice of word will follow Webster pattern--real American word its background in our country etc. Spelling bee will come from these words.
   - B. If a program for an assembly is prepared, different children will present a sketch of the various steps in the educational frustrations he encountered and how he solved them.--need for better readers, need for spellers, need for grammar books, need for an American dictionary, need for high schools for his girls, need for Americanizing the spelling of many English words. Stress the specialness of his dictionary over even others of today. Learn to recognize the symbol of a Noah Webster dictionary over any other Webster dictionary.

C. Musical theme for the program - use the music and tune from "The Candy Man" but wirte new words "The Dictionary Man"

VII Materials Needed

Reference book 40 American Biographies

Xerox Education Publications
Education Center
Columbus, Ohio 43216

Using the Kil-she-nchr-ee	three copies each grade level for each building
Chumpy's Word Games	six copies each building

HAVE A BALL AT THE COLONIAL MALL

I. Setting:

A. Different learning centers located around the I.M.C. for craftsmen.

1. Examples of antiques or replicas to demonstrate these crafts should be exhibited along with students work as the unit progresses.

II. Background of colonial crafts

A. I.M.S. should be fimiliar with the collowing crafts and direct the children to the books in the I.M.C.

1. Shoemaking
2. Whaling
3. Shipbuilding
4. Gardners
5. Candle makers
6. Masons
7. Carpenters
8. Bakers
9. Tanning
10. Silversmith
11. Wigmaker
12. Weaver
13. Wine maker
14. Cooper
15. Potter
16. Glassblower
17. Cigar Making

III. Development of Crafts

A. Wignmaker - Bring in wigs

Study how important wigs were at that period of history

Style the wigs - use curling iron or plastic curlers

B. Baker Make old fashioned ginger cookies and or bread

C. Candle maker Dip candles in wax to show how long it takes to build up enough wax on the wick to have a finished candle

D. Potter Pottery can be made and fired - practical everyday pottery such as dishes, clay pipes.

E. Printing Show how pages of a book were numbered, folded and cut by using big sheet of paper

Study early printing and discuss formation of the letters

Print an old fashioned newspaper using 18th century style print and news items

Print a receipe book of early American dishes

Use a rubber stamp printing set to establish the concept of how type was set

Have a speaker come from a local newspaper to show how modern type is set. If possible take a field trip to see how this is done

F. Weaver — Make hand looms (wooden block with nails)

Make samplers

G. Gardening — Plant an herb garden in the classroom. Discuss how herbs were used for cooking and medicinal purposes

After the herbs are grown, dry and use them as the colonists did

IV Speakers and/or films

A. Borrow Colonial Williamsburg films on craftsmen from the Intermediate Unit

B. Invite parents and grandparents in to demonstrate different crafts

V Materials needed

A. Materials for each craft listed

ATTACHMENT C

HIGHLANDS SCHOOL DISTRICT

TOPIC: Minutes of the Career Education Planning Committee

DATE: January 17, 1975

The Career Education Planning Committee, with Mr. Romito presiding, met in the conference room of the Intermediate School on January 17, 1975 at 10 a.m.

Those in attendance were:

Dr. Nick Staresinic	Superintendent of Highlands
Mr. Andrew Romito	Highlands BHQ Coordinator
Mr. Michael Davidek	Vocational Guidance Counselor
Mr. Charles Schmitt	Federal Funds Director/Public Relations
Mr. Robert Susini	Assistant Principal--Senior High
Mr. Pat Guzzi	Director of Voc.-Tech. Education
Mr. G. Fred Thickey	Elementary Coordinator
Mrs. Jane Robertson	BHQ Project Director
Mrs. Irene Ravigoni	Allegheny Valley Chamber of Commerce
Mr. Joseph Kocon	Elementary Principal
Mrs. Martha Kuhn	Acting Secondary Coordinator
Mr. George DeWitt	P. P. G. Industries, Inc.
Mr. Clyde E. Smith	Oberg Manufacturing Co., Inc.
Mr. James Podrasky	Student Representative
Mr. Michael Kanieki	Student Representative

Order of Business:

1. Mr. Romito distributed minutes of the October 21, 1974 meeting and several minutes were spent perusing them.

2. James Podrasky and Michael Kanieki discussed a television project in which they are involved at the Senior High School. Under the direction of Mrs. Paula Weidl, speech instructor, they and other members of her classes have been presenting a children's show entitled "Our Shoe Box," on Channel 3, a local station. Scripts en toto were done by students; all students were assigned to some phase of production in this Community Involvement Program. As an outgrowth of this project, some students have expressed more interest in perhaps investigating possible television careers.

3. Coordinator's Report:

   Mr. Romito announced that Career Day is scheduled this year for February 12, Wednesday, and will involve grades 7 through 10. St. Joseph's and Blessed Sacrament will be included and the Junior High for the first time will be involved.

   He reported briefly on the Highlands In-Service Day which was held on Nov. 6, 1974. Judging from the evaluation sheets, this day was worthwhile.

   Mr. Romito also informed the committee that "Career Based Color-Coded Cards" now printed and being circulated in grades 7 through 10. Cards for grades 11 and 12 will be ready soon.

Three Career Resource Centers are operating in the secondary schools plus one Elementary Resource Center to service the ten elementary schools.

4. BHQ Project Director's Report:

Mrs. Jane Robertson, BHQ Project Director, informed us that she has been invited to Dallas, Texas, on January 27 and 28, 1975 to "chair" the Project Director's Committee for this national convention. She announced that our Secondary Card Files hopefully will be disseminated to other areas in the country since there is such a lack of progress elsewhere in this area. After much discussion several questions were finally raised:

A. Is is right to give this material nationally to others before we are using it effectively within our own three involved districts?

B. Have we met our own needs yet?

C. Should we wait until we are on firmer ground ourselves and have completed our own insightful evaluation?

The following conclusions were reached: the final evaluation of our project should be at the federal level and done by the Office of Education; if any reprints of our material are done, this should be done also at the federal level--we are not in the printing business.

It was further recommended by the committee that the 250 copies to be made available at the national convention should be procedural--not the actual finished product. It was also determined that the 3 involved school districts should make a joint decision as to how our project should be presented in Dallas. The Intermediate Unit should be our first concern--not the whole United States!

5. Vocational Guidance Counselor's Report:

Mr. Davidek informed us that the Career Resource Centers are receiving the most use at the Intermediate School and at Highlands Jr. High. He announced that the Student Vocational Assessment Van will be here on February 3 for aptitude testing and evaluating of students. This testing will be done during school hours. He told us that to date he has presented our Cooperative Programs to more than 1500 students, and that to date the involved students have earned more than $66,000 this term.

6. Elementary Coordinator's Report:

Mr. Thickey feels that lack of time to develop materials and share ideas at the elementary level is a vital concern and problem. He told us that Grades 3 and 6 now have complete card sets for career emphasis. He recommended that each principal have available a supplementary set so more use can be made of this material. Dr. Staresinic said his office will willingly conduct a survey in the elementary schools to secure "feedback" of what needs are greatest at this level if properly informed as to what information would help.

7. Acting Secondary Coordinator's Report:

Mrs. Kuhn reported that much unpublicized work is "on-going" at the secondary levels, but several projects were mentioned for emphasis:

A. Marsha Watson, home economics teacher in the jr. high, took her students to the beauty academy in New Kensington to show career possibilities and emphasize personal grooming as an asset for work.

B. All 9th grade social studies teachers have planned units using the Career Resource Centers for individualized investigations. Comprehensive written and oral reports are results of this project.

C. In 10th grade, Mrs. Malobicky specifically emphasizes career opportunities in the business areas, and in the near future plans to take students to GeeBee to become aware of various jobs and their availability.

D. In 11th grade, Mr. Sydlick, American History Instructor, takes 10 to 15 minutes to detail any career which arises within the framework of the lesson.

E. In 12th grade, Mrs. Gestner, economics instructor, uses role-playing techniques in "crime" unit. Jury tirals are held in mock situations to emphasize various areas. Applications from local industries are also used for practical value of knowing how to best apply for a job and present oneself in the most positive way.

F. Mr. Guzzi's career programming in vocational-technical programs continues always on a daily basis.

G. Mr. Chet Gill, our Job Placement Coordinator, works very diligently. He has a group of 25 students in the D.O.E. Program (Diversified Occupation Education), as well as other occupational groups within the school. Job placement is a function receiving more and more emphasis and a relatively new service for Pennsylvania employers has been developed called the CAPS System (Computer Assisted Placement Services). This "print-out" should be available to industry by spring. Its purpose is to provide specific information about public and private school occupational program graduates.

8. Allegheny Valley Chamber of Commerce Report:

Mrs. Ravigoni announced that some 90 careers will be presented on Career Day, Feb. 12. The format will be the same as in previous years. Eighty percent of the speakers are confimred. This program is coordinated through the business--community--school spectrum. Other Chamber of Commerce have been asking for materials and information re our "Career Info." Total community cooperation and involvement is the necessary ingredient for success. We have had such cooperation, Mrs. Ravigoni emphasized.

9. Remark:

Dr. Staresinic announced that Dr. Pittenger will be visiting our district sometime in February. He is interested in our total program and plans to interview students and teachers plus possibly teach a class during his stay.

Mr. Pat Guzzi added the statistic that 900,000 students will leave school this year. All students must work at one point--what he will do and how he will do it is a concern for all of us, he said.

The meeting adjourned at 11:50 a.m.

Submitted by,
Martha Kuhn

ATTACHMENT C

HIGHLANDS SCHOOL DISTRICT

TOPIC: Minutes of the Career Education Planning Committee

DATE: April 9, 1975

The Career Education Planning Committee, with Mr. Romito presiding, met in the conference room of the Intermediate School on April 9, 1975, at 10 a.m.

Those in attendance were:

Mr. Andrew Romito	Highlands BHQ Coordinator
Mr. Michael Davidek	Vocational Guidance Counselor
Mr. Charles Schmitt	Federal Funds Director/Public Relations
Mr. Robert Susini	Assistant Principal - Senior High
Mr. Pat Guzzi	Director of Voc.-Tech. Education
Mrs. Nancy Myford	Elementary Coordinator
Mrs. Jane Fortney	BHQ Project Director
Mrs. Irene Ravigoni	Allegheny Valley Chamber of Commerce
Mrs. Martha Kuhn.	Acting Secondary Coordinator
Mr. George DeWitt	P.P.G. Industries, Inc.
Mrs. Norma Stockdale.	Community Affairs
Mrs. Aldona Grina	New Kensington--Penn State Center
Mr. Earl Dodrill.	U. S. Office of Education
Mr. Ray Miller.	Project Director--Parkersburg, W. Va.
Miss Amy Haugh.	Student Representative

Order of Business:

1. Mr. Romito distributed minutes of the January 17, 1975 meeting and several minutes were spent perusing them.

2. Introductions:

Mrs. Nancy Myford was introduced as the new Elementary Coordinator. Mrs. Myford is a third grade teacher at Prospect School and replaces G. Fred Thickey. The new post High School Representative is Mrs. Aldona Grina, Counselor for the Penn State--New Kensington Campus. Miss Amy Haugh, a new 10th grade student representative, was also introduced to the committee. Earl Dodrill, from the U.S. Office of Education, and Mr. Ray Miller, Project Director from Parkersburg, W. Va., were special guests. The gentlemen were on-site visitors evaluating the BHQ Project. Mrs. Jane Robertson was re-introduced as Mrs. George Fortney, in accordance with her recent marriage.

3. Elementary Coordinator's Report:

Mrs. Myford reminded the members of a special program that was produced by Highlands students about Earth Week.

She stated that 100 more color-coded cards were added to the file and that the cards were working. The set of cards for Kindergarten, first and second grades were complete. The set for 4th, 5th, and 6th grade cards are being completed presently. Mrs. Myford stated that field trips and certain WQED television programs were an asset to Career Education. Mrs. Myford felt that better communications and more feedback were necessary.

4. Secondary Coordinator's Report:

Mrs. Kuhn stated that a set of color-coded cards have been given to each Instructor; however, only three teacher have supplemented information. One suggestion was that retired people work with teachers in-service throughout the year. The CAPS System (Computer Assisted Placement Services) was explained by Mr. Guzzi, who suggested that local employers and prospective employees be made aware of the service.

5. CRC Chairman's Report:

Mr. Davidek stated that the four centers were going strong. The Senior High School Center was open twice a week and the Center at the Heights Building was doing fine.

6. Community Resource Committee:

Mrs. Ravigoni reported that at the beginning of the next school term retired people of the community will be available as resource personnel for classroom presentations.

7. BHQ Career Year End Wrap-Up:

Mrs. Fortney thanked Mrs. Ravigoni and the entire committee for their positive attitude and sincere effort. A discussion was started about the preparation of high school students for the outside world, whether it be further education or a job. How well are teachers preparing themselves and their pupils for the future? A few suggestions were brought forth for teacher and counselor improvement courses. Mrs. Grina was in favor of planning several workshops to improve articulation between post high school and our secondary institutions. She plans to submit a proposal for review and study.

8. Projection for 1975-1976:

Mr. Romito also thanked everyone for their hard work. He stated that the project started with the support of 13 teachers. We now have about 200 teachers or 2/3 of the professional staff involved in Career Education. The goal for next year is 100 percent cooperation.

The meeting was adjourned at 12:10.

Respectfully submitted,

Amy Haugh, Student Representative

ATTACHMENT C

HIGHLANDS SCHOOL DISTRICT

CAREER EDUCATION PLANNING COMMITTEE

Meeting Date April 9, 1975

AGENDA

1. Review of minutes

2. Introduction of new members of C.E.P.C. and special guests

3. Elementary Coordinator's Report -- Mrs. Myford

4. Secondary Coordinator's Report -- Mrs. Kuhn

5. CRC Chairman's Report -- Mr. Davidek

6. Community Resource Committee Report -- Mrs. Ravigoni

7. BHQ Careers Year End Wrap-Up -- Mrs. Fortney

8. Projection for 1975-1976 -- Mr. Romito

ATTACHMENT D

CAREER CONSULTANT PROGRAM

Objective: To provide students with continuing personal contacts with adults which foster career exploration.

A. CAREER CLUSTERS CONSULTANTS

1. Contact of consultants in these fields for availability, time, day/week/month.
2. Career clusters:

Accounting	Data Processing and Computer
Advertising, Marketing and Public Relations	Education
Agrebusiness and Natural Resources	Electronics
Automotive	Engineering
Architecture	Environment
Banking, Finance Investment	Food Service and Processing
Business and Office Services	Government
Communication and Media	Health and Medicine
Construction	Hospitality and Recreation
Correction, Law and Security	Industry
	Machine and Tool Trades
	Personal Services
	Sales
	Science
	Social Work
	Transportation

B. WHAT INFORMATION WOULD CONSULTANTS PRESENT

1. They can provide accurate, current and relevant information regarding all aspects of their occupation. The presentation should include the following elements:

   a. Emphasize the interdependence of occupations within the career cluster. Talk about their career relative to others.
   b. Discuss the typical situations or problems presented by their occupations, the tools or knowledge necessary, etc.
   c. Role play some typical situations they encounter in their work.
   d. Define the characteristics of the people they serve and the individuals with whom they work.
   e. Describe the effect, if any, which change and automation have had on their work.
   f. Relate how one advances or moves to other occupations within the particular career cluster.
   g. Indicate what they wish they had known about the occupation before entering it and what they might have done differently.
   h. Describe the greatest personal satisfaction and the most serious frustration in the work.
   i. Discuss the immediate employment situation in the career field and project trends which may have bearing on the future.
   j. Outline the different routes occupationally and/or educationally one might take to get into the particular career including licensing, certification and other special requirements.
   k. Avoid emphasis on occupational conditions such as salary, fringe benefits, etc. Mention, but don't emphasize.
   l. Allow time for questions and answers.
   m. Use visual aids, pass out materials, if possible.

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date _____

Name and Address _____
Give exact title

_____

Telephone Number (where you may be contacted by teacher) _____

Telephone Contact - During Day _____ After working hours _____

Grade Level Preference _____

Availability - Weekly _____ - Day of Week _____

Monthly _____ Other _____

Career Subject _____

Presentation needs - audio visual, etc.

_____

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning _____ Afternoon _____

You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

The above data will be placed on file in the Resource Centers in the Highlands School District.

PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date MARCH 13, 1975

Name and Address JOHN S. HOUZE 136 STEEP RD. SAKLER, PA. 16055
Give exact title
SALES REPRESENTATIVE

Telephone Number (where you may be contacted by teacher) 224-5300

Telephone Contact - During Day X After working hours ____

Grade Level Preference 10 - 12

Availability - Weekly ____ - Day of Week ____

Monthly ____ Other QUARTERLY

Career Subject SALES - INSURANCE

Presentation needs - audio visual. etc.

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning ____ Afternoon X

You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

The above data will be placed on file in the Resource Centers in the Highlands School District.

PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

ATTACHMENT D

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date MARCH 13, 1975

Name and Address PAUL PEIFFER, 100 OXFORD DR APT 308, MONROEVILLE PA.
Give exact title
Production Engineer

Telephone Number (where you may be contacted by teacher) 221-6500, EXT 289

Telephone Contact - During Day ✓ After working hours _____

Grade Level Preference Senior High

Availability - Weekly _____ - Day of Week Friday

Monthly ✓ Other _____

Career Subject Engineering → mechanical

Presentation needs - audio visual, etc.

over-head projector

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning _____ Afternoon ✓

You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

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PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

ATTACHMENT D

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date MARCH 14, 1985

Name and Address Robert A Hanson Jr 312 E 6th Ave. Tarentum PA 15084
Give exact title: Vice President - Marketing - Lovell & Lindquist Co

Telephone Number (where you may be contacted by teacher) 224-5300

Telephone Contact - During Day ✓ After working hours ____

Grade Level Preference High school

Availability - Weekly ✓ - Day of Week ____

Monthly ____ Other ____

Career Subject INSURANCE

Presentation needs - audio visual, etc.

Blackboard only

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning ✓ Afternoon ____

You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

The above data will be placed on file in the Resource Centers in the Highlands School District.

PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

ATTACHMENT D

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date MARCH 13, 1975

Name and Address EDWARD R. CROWE PRODUCTION ENGINEER
Give exact title
1751 KIMBALL AVE ARNOLD, PA. 15068

Telephone Number (where you may be contacted by teacher) [redacted] 224-6500 EXT. 408

Telephone Contact - During Day ✓ After working hours ____

Grade Level Preference SENIOR HIGH SCHOOL

Availability - Weekly ____ - Day of Week ____

Monthly ✓ Other ____

Career Subject ENGINEERING

Presentation needs - audio visual, etc.

OVERHEAD PROJECTOR

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning ____ Afternoon ✓

You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

The above data will be placed on file in the Resource Centers in the Highlands School District.

PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

ATTACHMENT D

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date March 13, 1975

Name and Address Donald W. Oldershaw, Union National Bank Tarentum
Give exact title Vice President

Telephone Number (where you may be contacted by teacher) 224-5000

Telephone Contact - During Day x After working hours _____

Grade Level Preference Junior High up

Availability - Weekly _____ - Day of Week _____

Monthly _____ Other Quarterly

Career Subject Banking

Presentation needs - audio visual, etc.

Possibly - sound projector

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning _____ Afternoon x

You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

The above data will be placed on file in the Resource Centers in the Highlands School District.

PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

ATTACHMENT D

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date 21 MARCH, 1975

Name and Address LEYDEN G SEIGART, TOOL & DIE MAKER
Give exact title
OBERG MFG CO INC - SILVERVILLE RD. - FREEPORT, PA

Telephone Number (where you may be contacted by teacher) _____

Telephone Contact - During Day 295-2121 After working hours 226-1638

Grade Level Preference 8/9

Availability - Weekly _____ - Day of Week ANY

Monthly ✓ Other _____

Career Subject MACHINE & TOOL TRADES

Presentation needs - audio visual, etc.

WILL SUPPLY OWN - A PLANT TOUR COULD POSSIBLY BE ARRANGED IF DESIRED

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning _____ Afternoon ✓ EITHER IS OK

You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

The above data will be placed on file in the Resource Centers in the Highlands School District.

PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

ATTACHMENT D

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date MARCH 2, 1975

Name and Address JAY SEKERES — SR. DESIGN ENGINEER
Give exact title
PPG INDUSTRIES INC. WORKS #1 CREIGHTON PA.

Telephone Number (where you may be contacted by teacher) _____

Telephone Contact - During Day 224 6500 Ext 346 After working hours [redacted]

Grade Level Preference SENIOR OR JUNIOR High

Availability - Weekly _____ - Day of Week Tuesday

Monthly _____ Other _____

Career Subject CIVIL ENGINEERING

Presentation needs - audio visual, etc.

UNKOWN AT THIS TIME

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning _____ Afternoon X

You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

The above data will be placed on file in the Resource Centers in the Highlands School District.

PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

ATTACHMENT D

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date MARCH 19, 1975

A Name and Address LOYD & LINDQUIST INC.
Give exact title 312 E. 6TH AVE.
TARENTUM PA. 15084

Telephone Number (where you may be contacted by teacher) _____

Telephone Contact - During Day 224-5300 After working hours AA 224-4232

Grade Level Preference HIGH SCHOOL OR JR. HIGH

Availability - Weekly _____ - Day of Week _____

Monthly _____ Other QUARTERLY

Career Subject INSURANCE

Presentation needs - audio visual, etc.

WE CAN SUPPLY OUR OWN

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning ✓ Afternoon _____

You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

The above data will be placed on file in the Resource Centers in the Highlands School District.

PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

A ELMER H. FRIES
ROBERT D. LEONARD
ROBERT A. HANSEN
JOHN S. HOUZE

AVAILABLE ALTERNATELY ON A QUARTERLY BASIS

AA ELMER H. FRIES, HOME PHONE 126

ATTACHMENT D

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date March 15, 1975

Name and Address Joseph H. Buschhammer 514 West 8th. Ave. Tarentum,
Give exact title
Electrical Foreman, Construction & Maintenance

Telephone Number (where you may be contacted by teacher) 224-6500 Ext. 309

Telephone Contact - During Day above After working hours 224-0938

Grade Level Preference does not matter

Availability - Weekly _____ - Day of Week Monday thru Thursday

Monthly yes Other _____

Career Subject electrical, air conditioning, and instrumentation trades

Presentation needs - audio visual, etc.

none, except perhaps a blackboard.

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning _____ Afternoon preferred

You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

The above data will be placed on file in the Resource Centers in the Highlands School District.

PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

The above crafts are at the tradesman's level and any discussion should include apprenticeships, future in crafts, and the satisfaction in doing.

I will help in any way I can.

ATTACHMENT D

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date March 26, 1975

Name and Address Philip Marcy 207 Third St., Freeport, Pa. 16229
Give exact title
Superintendent - Maintenance & Yard

Telephone Number (where you may be contacted by teacher) 224-6500 Ext. 216

Telephone Contact - During Day x After working hours _____

Grade Level Preference Jr. & Sr. High School

Availability - Weekly _____ - Day of Week _____

Monthly _____ Other Quarterly

Career Subject Engineering - Industry

Presentation needs - audio visual, etc.

Unknown at this writing

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning x Afternoon _____

You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

The above data will be placed on file in the Resource Centers in the Highlands School District.

PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

ATTACHMENT D

CAREER CONSULTANT PROGRAM
HIGHLANDS SCHOOL DISTRICT
COORDINATED BY ALLEGHENY VALLEY CHAMBER OF COMMERCE

PLEASE PRINT

Date 3-19-75

Name and Address Paul A. Rockar R.D. #2 Cabot, Pa 16023
Give exact title Production Supervisor

Telephone Number (where you may be contacted by teacher) 352-1009

Telephone Contact - During Day 224-6500 ext 423 After working hours 352-1009

Grade Level Preference 10th 11th

Availability - Weekly _____ - Day of Week _____

Monthly _____ Other Quarterly

Career Subject Production Management

Presentation needs - audio visual, etc.
Black board

PLEASE NOTE: The time of presentation would be during the school day. Please indicate MORNING or AFTERNOON preference.

Morning _____ Afternoon X

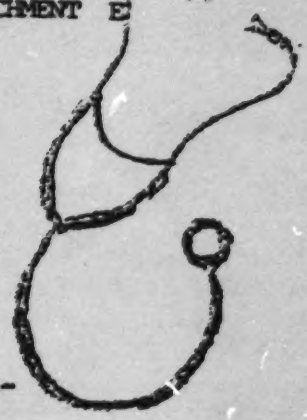
You will be contacted by the teacher and all arrangements made by them, not by the Chamber of Commerce.

The above data will be placed on file in the Resource Centers in the Highlands School District.

PLEASE RETURN TO: Allegheny Valley Chamber of Commerce
327 E. Sixth Avenue
Tarentum, PA 15084

ATTACHMENT E

Third Grade News
January 31, 1975



ear Parents:

We would like to thank Dr. and Mrs. Montgomery for giving f their time to talk to us about what a doctor does. Dr. Montmery brought out the point that doctors are usually fathers d that he can be our friend. Dr. Montgomery showed the children some of he equipment that he works with. He, also, let the children use some of is equipment with his supervision. Among other things, Dr. Montgomery emonstrated how to make a cast, how to test reflexes, and how to use the any kinds of splints. He used children in the class to allow boys and irls to see what tonsils look like. Not only was this an excellent career ducation experience, but it, also, was an excellent health lesson.

We will practice and prepare writing specimens to be sent to the Peterson Writing Company in Greensburg next week.

We will begin our unit about dental care in health class. Next week is ational Children's Dental Health Week. We have many activities for this nit. Our unit will include dental examinations which the school dentist ave this week. Our unit will, also, include reading, discussion, and a lay. Our children will receive dental kits and have an opportunity to rush their teeth and test to see whether or not they brushed properly.

In spelling the green group will work with unit 20, working with the t" sound. Their tests on columns one and two will be on Tuesday and Wednesday. Their tests on columns three, four, and five will be on Thursday and riday. The blue group will work with unit 22, working with the "o" sound ing "o" and "ow". Their tests on columns one and two will be on Tuesday d Wednesday. Their tests on columns three, four, and five will be on hursday and Friday. The yellow group will do two pages per day in their ooks. They will be tested on words from their reading. Their tests will on Wednesday and Friday.

In social studies, we will read about lumber and bricks for building.

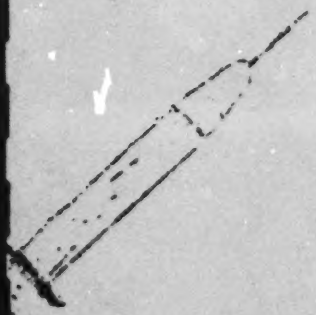
In English, we will complete our study of antonyms; review homonyms, nonyms and antonyms; and test near the end of the week.

In science, Mrs. Minarcin will continue her unit concerning measuring rop by drop.

In arithmetic, both classes will continue work with addition and subtraction.

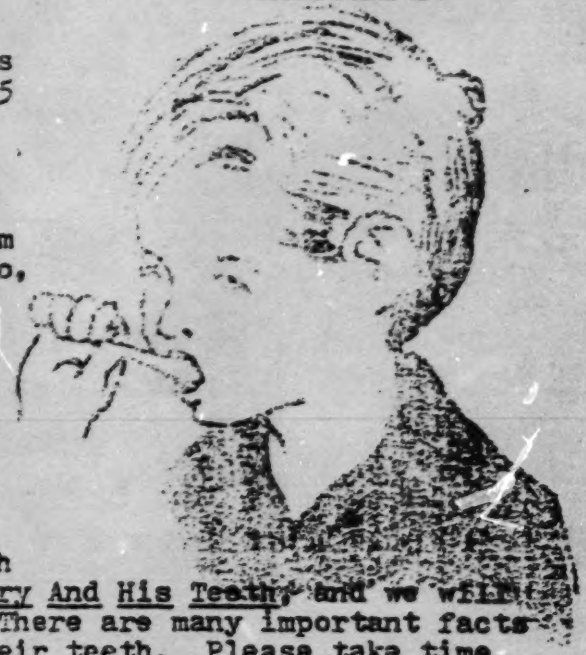
Sincerely,

Mrs. Bette Minarcin
Mrs. Kathryn Hultgren



ATTACHMENT E

Third Grade News
February 7, 1975



Dear Parents,

Next week is "Black History Week." In honor of our "Black Americans," we saw a film about George Washington Carver. We are, also, continuing our story about Harriet Tubman.

We are well into our unit on the study and care of teeth for "National Children's Dental Health Week" which is this week. Our study will continue throughout the next couple weeks. Besides our unit, in our health book, we will read a chapter about teeth from the Exploring Science book, do a play entitled "The Trial of the Dental Health Six," work in a cartoon booklet entitled Terry And His Teeth, and we will see several selected films and filmstrips. There are many important facts that your children should know concerning their teeth. Please take time to listen to your child concerning what he has learned in school.

Some of our children received parts for the play. Please help your child learn his part.

Mrs. Hultgren's Rainbows received their next reading book, Signposts.

In social studies, we will study about bricks for building, review, and test. We will, also, continue our study of map skills.

In English, we will continue our review of homonyms, synonyms, and antonyms; and test on this unit. We will begin writing our "Patriotic" theme near the end of the week. This theme, along with three other third grade themes, will be placed in their folder to be sent to their next teacher.

In arithmetic, Mrs. Hultgren's class will continue work with addition and subtraction. Mrs. Minarcin's class will begin a unit on multiplication and division on Monday. They will work with the "0" and 1" times tables.

In spelling, the green group will do unit 21, working with the "ch" and "j" sounds. We will test on columns one and two on Tuesday and Wednesday and columns three, four, and five on Thursday and Friday. The blue group will work with unit 23, working with the "o" sound. Their tests on columns one and two will be on Tuesday and Wednesday and columns three, four, and five on Thursday and Friday. The yellow group will do two pages per day in their spelling books. They will be tested on words from their reading on Wednesday and Friday.

Sincerely,
Mrs. Lettie Minarcin
Mrs. Katarina Hultgren

ATTACHMENT F

MEMO TO:

FROM: Nick J. Staresinic, Superintendent
Andrew S. Romito, BHQ Coordinator

DATE: May 22, 1975

SUBJECT: ON-SITE VISITATION BY THIRD PARTY EVALUATOR, EDUCATIONAL RESEARCH AND DEVELOPMENT ASSOCIATES (ERANDA), WEST CHESTER, PENNSYLVANIA.

Sechdule	Tuesday, May 27, 1975	
Junior High School	9 a.m. - 9:35	Mr. Kline Mr. Allen Ms. Mamula Mrs. Rose Mrs. Sasfai Mr. Henderson
First Ward	9:45 - 10:15	Mr. Kocon Mr. Schmitt Mrs. Lokar Mrs. Krumenacker Mr. Clark
Prospect	10:30 - 11:00	Mrs. Myford Mr. Davis Ms. Bernacki Mrs. Peffer
Fairmount	11:10 - 11:40	Mr. Podrasky Mrs. Minarcin Mrs. Hultgren Mrs. Kuhnert
Birdville	11:50 - 12:15	Mr. Poprik Mr. Danish Mr. Keryeski Mrs. Sporcic Mrs. Stover

NOTE: Sorry for the short notice. Your cooperation and understanding will be appreciated. Thank you.

jmy

Highlands School Dist.

74-75

Andy, here is a report on the students going to Forbes Road East Area Vocational-Technical School for exploration during the Summer.

① Accounting, Data Proc., Hotel/Motel } 3

② Research Lab Asst., Civil Const., Electronics } 3

③ Meatcutter, Baking, Cook/Chef } 7

④ Auto Diagnostic, Auto Service, Machine Shop } 3

⑤ Dental Asst., Med. Sec'y., Med. Asst. } 16

⑥ Civil Construc., Electricity, Carpentry/Cabinet } 7

⑦ Auto Mech., Welding, Auto Body } 15

⑧ Data Proc., Appliance Rep., Electronics } 1

⑨ Data Proc., Marketing, Ware housing } 0

⑩ Health Asst., Cosmetology, Marketing } 6

⑪ Auto Diag., Auto Body, Heat/Air Cond. } 0

⑫ Printing, Com. Art., Tailor/Dressmkg } 4

Total Enrollment: 64

Submitted by

M. Davidek
Voc. Counselor

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ATTACHMENT G

Name _____ My Career Contract

1. What I like best about (a career) _____.
This should be a well written paper of a least 2 full pages in length. Your knowledge, your personal opinions, your research and your creative writing ability will make this a pleasure to read.

2. I wish I was a (a career).
Here again it is your opinion that counts. THINK! RESEARCH! DREAM! Form an opinion and express it.

3. (a career) future looks _____ because
You may fill in the blank with any word of your choice. Then support your choice with information you can gather.

4. Pick out one aspect of this career. Write a short story on its origination, activities, approximate dates, training or any other interesting information. Then make a poster to advertise a job opening in your career.

5. Use the Want ads of the newspaper. List the job openings for your career choice. List the training or experience necessary for that job. You might even find the salary offered for this ad.

6. Organize articles, pictures, uniforms, hats, tools etc. for a bulletin board display of your career.

7. Invite in a resource person who has earned a living in your career choice.

8. Put on a "mock interview" for your career

Contract for
Career continued

9. Pantomime your career.
10. Make 20 questions for "What's my Line". Include the answers.
11. Make up an original game for your career.
12. Write a song or a poem about your career.
13. How does your career tie in with Math, Social Studies, Language Arts, Science, Health, and the arts (art, music, literature)
14. Make a vocabulary list of words particular to your career.

I _____ have read and thought that during the next two weeks, ending _____, I could fulfill a goal and complete activity numbers ____, ____, and _____.

ATTACHMENT I

QUAKER VALLEY SCHOOL DISTRICT

October 7, 1974

TO: All Professional Personnel

FROM: Dr. Kite

SUBJECT: In-Service Workshop - October 14, 1974

PLACE: Junior High School

8:30 - 9:00 - Coffee - Junior High Cafeteria

9:00 - 9:10 - Dr. G. V. Bedison - Introduction of Subject

9:10 - 9:45 - Vocational Information & Evaluation Center - Mr. Charles Wendel

9:45 - 10:00 - Mr. R. J. Powers - Background on last year's B.H.Q. Project and what is planned for this year. Introduction of the card file curriculum system will be covered.

10:00 - 10:15 - Break

10:15 - 11:00 - Break into grade or department level meetings to work with teachers that are now in the project and some teachers from last year.

11:00 - 12:00 - All equipment will be set up in gym for all teachers to view (and representatives from companies are to have a display of new materials in career education).

1:30 - 3:00 - Elementary - Parent-Teacher Conferences
Secondary - Department Meetings

The morning session has been arranged by Mr. Powers and the B.H.Q. Career Education Project.

Departmental Meetings

Department	Meeting Room
English and Reading	113
Social Studies	102
Mathematics	105
Science	212
Music (Elem. & Secondary)	Choral Room
Business Education & D.E.	114
Industrial Arts	Drawing Rm.-Shop
Art (Elem. & Secondary)	Art Room
Home Economics	13
Physical Education & Health	103
Foreign Language	104
Guidance	108
Librarians (Elem. & Secondary)	Library

Each department should appoint a chairman and recorder. Any significant recommendations should be forwarded to me following the meetings. All constructive suggestions will be welcomed.

GUIDELINES

Although meetings are held from time to time by each department in each of the secondary buildings, location and time do not permit meetings to take place very often in which all secondary teachers in a department can exchange information and views.

With changes developing in approaches, techniques, content and curriculum requirements, it is essential that each of us constantly reevaluate the educational program in the Quaker Valley Schools to provide vertical articulation.

Each department member should plan to participate in these meetings and to come prepared to offer suggestions concerning his particular subject area as well as to participate in discussions which should lead to a better understanding of the total secondary program in our schools.

In light of the present emphasis on equal opportunity for girls in education, program descriptions should be reviewed to update the material so that statements are not stated in such a way as to indicate sexism.

ATTACHMENT I

HIGHLANDS SCHOOL DISTRICT

TO: Professional Staff (K-6 and 9-12)

FROM: Nick J. Staresinic, Superintendent

DATE: October 31, 1974

SUBJECT: Professional Growth Meeting - Senior High School Auditorium
Wednesday, November 6 - 1:05 p.m. - 3:05 p.m.

TOPIC: CAREER EDUCATION

The schedule of activities is as follows:

Greetings and Introductions	Mr. Andrew S. Romito - BHQ Coordinator, Highlands Mr. Nick J. Staresinic - Superintendent of Schools Mrs. Jane Robertson - BHQ Director
General Overview of Career Education	Dr. Michael Ciavarella - Career Development Center Shippensburg State College
Movie - Career Education	"Let's Get To Work" Britannica Educational Corp.
Explanation of Career Card File System	Mrs. Jane Robertson

ADJOURNMENT

NOTE: All K-6 and 9-12 professional personnel are expected to adhere to the following:

1. Assemble by 1 p.m. (please be punctual)
2. All are expected to attend. (Any request for absence or early release is to be directed to my office).
3. No dismissal prior to 3:05 p.m.

This continues our planned series of professional growth meetings. If they are to be meaningful and productive, the cooperation of all professionals is essential.

Thank you.

bmn

Child Care Services

HIGHLANDS SENIOR HIGH SCHOOL

1. INTRODUCTION

There are seven vocational cooperative programs in existence at the senior high school. Look at the following chart:

VOCATIONAL CO-OPERATIVE EDUCATION

Business Co-Op	Distributive Education	Diversified Occupations	Health Occupations	Home Economics
				1. Foods & Nutrition 2. Cloth. & Text. 3. Child Care Serv.

In each of these programs, a student must take the required courses for graduation, and the required courses for graduation in his/her particular vocational co-op program. In addition, the student may elect as much as he/she has time to elect In each program, there are both students who are planning to get a job immediately after high school graduation, and, students who are going for further education (colleges, 2-year schools, tech. schools, etc.).

Just to give you an example, in the child care services class of '76, one girl is there because she wants to become a better babysitter and eventually, a better-informed mother. Another girl wants to become a child psychologist which will require a minimum of five to six years of college.

VOCATIONAL CO-OPERATIVE EDUCATION IS FOR EVERYONE!
Your job is to find out which program suits you best.

2. THE PROGRAM

Within the child care services program, there are two courses which are required. They are:

a) Child Care Services I, Juniors only, 7 periods per week, 36 weeks, 1 2/5 credit.
b) Child Care Services II, Seniors only, PRE-REQUISITE: CCS I, 5 periods per week, 36 weeks, 1 credit.

There is also a possible third way to earn a credit in the child care services program . . . it is the

c) Co-operative Work Experience - This is the work experience for which

senior students who get a child care service related job can earn one credit in school. Notice, however, that this is a CO-OPERATIVE work experience. In other words, student learner, (that's you) must work in a place where the employer is present. That rules out the traditional kind of babysitting job.

Getting a co-operative work experience placement depends upon two factors:

1) the number of jobs available

2) your ability to handle that particular job.

If you are placed in a co-operative work experience, you will be eligible for released time from school. REMEMBER . . . the work experience is for seniors only.

3. THE LEARNINGS

During the junior year, the CCS I students get involved in self-discovery and personal understanding. Then they move right into leadership and citizenship training within their vocational club (FHA-HERO). After that, they become involved in a unit of child development, then, art - music - and reading workshops for children. There is also a co-operative FIELD experience called a practicum within the child care and/or educational establishments in the area.

A program of speakers is planned to help you with a unit on career exploration in the fields of service to children. Near the end of the year, each CCS I student will student teach in the nursery school at the senior high school conducted for the Child Development Course students. RED CROSS certificate programs . . . *

The senior year CCS II students go into the aspects of work and income, job interviews, etc. There is also additional child study.

4. THE REQUIREMENTS

There are a few requirements for entry and enrollment in the child care services program:

a) Tuberculin test -- with negative results, administered by the school, FREE.

b) Uniform -- a tunic top to be worn over clothing while participating in the practicum and student teaching experience. This identifies you as a student in the child care services program. (approx. 30)

---

*Two certificate programs are offered to child care services students through the RED CROSS: Mother and Baby Care and Home Nursing.

c) FHA-HERO — Membership and participating in the vocational club of Future Homemakers of America, Home Economics Related Occupations. Dues are $1.00 for national, $1.00 for state, and the chapter will make a decision by vote for the local dues.

d) Banquet - senior year only, an appreciation of employees and recognition of achievement for students enrolled in the vocational co-operative programs at Highlands. Approximate cost is subject to price changes. Usually it is $5.00 for students, and the same for the student's employer (which, incidentally, is the responsibility of the student).

Other expenses are at the discretion of the student. If he/she desires to attend trips and conferences through the vocational organization, or purchase special materials and books for personal use. An example would be the Red Cross Home Nursing textbook. These books and supplies will be provided by the school, but are the property of the school. Purchase is necessary only if the student wishes to keep the item.

5. PARENTAL CONSENT

The form below is to be completed by your parent or guardian for proof that the contents of these papers have been read and approved. Please detach and return the completed form to your guidance counselor who will then forward them onto the instructor of the child care services program. Any questions should be directed to:

. . . . . .detach here . . . . . .

Dear Miss Naptes,

I have read the above three pages regarding the child care services program and agree to my son/daughter's ___(NAME)_____ enrollment into the program.

PARENT/GUARDIAN _____

DATE _____

_____ I have a question about this program. Please call me at _____.
PHONE NO.

The best time to call is Hours _____, Days _____.

Or, _____ contact Miss Naptes at the Senior High School, 226-1000, from 7:15 a.m. to 3 p.m.

ATTACHMENT K

The Pittsburgh Press

Thursday, March 6, 1975 Page 25

Marland Pushes Career Learning

By ANDY SHAW

CHICAGO—A telephone lineman walks into a grade school class and talks to the children about how he uses math in his job.

A seventh-grader with an interest in journalism spends several days at a newspaper and later phones a reporter when something interesting happens in his school.

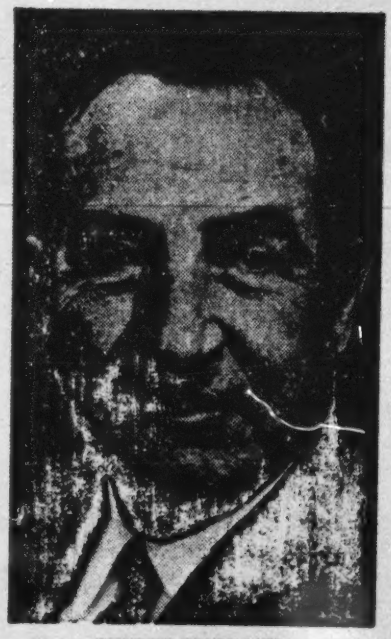
This is Sidney Marland's idea of "career education," a concept he says tries "to harmonize academic learning with occupational development at all levels. The objective is to give the individual learner more control over his own destiny and more motivation to learn."

Since students eventually become part of the work force, they should develop a better understanding of what occupations are about, including contact with employes, he feels.

Marland's idea is gaining momentum around the country. But familiar obstacles remain: Lack of funds, weak support from the private sector, uncertain leadership and the absence of a co-ordinated effort.

Also, since the concept is only a few years old, there is no proof that it is better for students than traditional programs.

Marland, who wrote the recently published "Career education: A Proposal for Reform," was U. S. Education Commissioner from 1970 to 1972 and HEW's assistant secretary of education for the next two years. Now president of the College Entrance Examination Board, he



SIDNEY MARLAND
Contact with work force.

previously held school superintendent positions in Winnetka, Ill., Pittsburgh, and Darien, Conn.

The need for career education, he explained in an interview here, arose because our society has virtually eliminated contact with students and the work force.

"I ask that workers become close friends of children so the youngsters develop perceptions about them and their given types of work," he says. "I ask literal experience in some enterprise for every high school student for his diploma . . ."

Math students, for example, might visit an accounting firm or have an accountant come to class, but not on a one-shot basis, Marland emphasizes. Ongoing contact with the work areas is important, he said.

He said opposition for his proposal comes from educators, who call the plan anti-intellectual; minority groups, who see it as another form of "tracking" them into menial jobs, and teachers who resist change.

Yet he noted that when critics have studied his plan, they have generally accepted it enthusiastically. And he sees it as one of the last chances to put meaning into the educations of poor children, who often lack motivation and understanding of their options in the work force.

Marland says his message should be spread this way: "Gain the attention of teachers so there becomes a nucleus of concerned and informed people in every district who say it's worthy of attention."

"Then, appoint a full-time deputy in every state's education department to "creatively" implement the program. Finally, set up a statewide advisory council "to bring business and labor into the school."

Chicago Sun-Times Service

142

Valley News Dispatch

An independent people's newspaper

Saturday, June 22, 1974—New Kensington-Tarentum-Vandergrift, Pa.

Highlands

SUPT. Nick J. Staresinic credits implementation of career education programs in Highlands School District for a trend toward direct employment by graduates within recent years.

Approximately 34 per cent, some 170 graduates, will enter or seek jobs this year. All but 40 of them already have jobs lined up, Staresinic said.

The addition of vocational-technical programs at Highlands and affiliation with vocational-technical schools within the area were also cited behind the significant change, according to the top administrator.

While a trend has been noted toward direct employment, more than half of the graduating class, 57 per cent, will attend college or post-high school education courses.

Some 187 graduates will attend colleges or universities: 29, community colleges; and 2, junior colleges.

TWENTY students will enroll in vocational or technical schools, 24 in business courses, 8 in nursing programs and 15 in related vocational classes.

Employment statistics show 37 grads will enter office jobs, 16 in sales, 22 in factory work; 14 in the building and construction trades, 18 in apprenticeship programs and 12 in other work areas.

Five per cent will enlist in the armed services and about 4 per cent are undecided.

Video tape equipment used to teach speech techniques

Video tape equipment provided through the federally-funded career education program has been getting wide use in the elementary schools. Teachers have been using the equipment in the classroom to film students in a variety of speech and interview situations. In addition, the equipment can be used to pick up trans missions from WQED to be shown whenever a class is in session.

Students in Byron Harriger's sixth grade class have been taping each other's book reports. During the replay students are able to see their mistakes. They quickly realize that they have distracting mannerisms such as fidgeting or rocking back and forth. They notice that they have not established eye contact or worn neat clothing.

The taping has been part of a long range unit planned in speech, interviewing, and job application techniques. At the beginning students were permitted to use extensive notes for their presentation. Gradually the notes permitted were reduced until students were able to rely on their own memories.

According to Mr. Harriger, the opportunity to see themselves via the monitor has been an invaluable aid in convincing students that a neat appearance is vital whether they are making a classroom presentation or interviewing for a job.

In another part of the unit, students practice filling out job applications for imaginary positions.

The career education program is in its second year at Quaker Valley. The project is also being tested in Baldwin-Whitehall and Highlands school districts. The emphasis is on giving students "career awareness" in each grade beginning with kindergarten. Every effort is made to weave the career emphasis into the regular classroom program so that students realize the "real world" importance of academic studies.

In the junior and senior high schools, the awareness is applied to specific careers and students begin to select specific professions that they study thoroughly.

Amy Erwin video tapes Eric Murrer's book report presentation. During the play back of the tape, students are made aware of any mistakes they have made in their presentation.

Green Circle awards set in Highlands

Edward Howell, Highlands School District director of elementary education, announced 32 presentations of a Green Circle Program will be made by Nov. 21.

Green Circle is a program on good human relations for children in the years when they are forming their ideas of the world and their relationships to other people.

This program was introduced in the elementary schools for the first time last year.

Purpose of the Green Circle is to help stimulate and reinforce in children positive social attitudes which are necessary to build a world where all men can live together as brothers and realize their highest potential.

The concept of the Green Circle is introduced by use of a flannel-board. The circle, which starts with the individual, continues to grow as it includes the family, friends, people of the community, the nation, and the world.

Throughout the demonstration there is participation by the children. The emphasis is on inclusion as contrasted with rejection because of difference, whether the difference be of race, religion, nationality, wealth, size, physical or mental handicap.

Highlands Green Circle program has four elementary teachers. They are Mrs. Katherine Hultgren, third grade teacher in Fairmount Elementary; Mrs. Sue Derikart, second grade teacher in 1st Ward Elementary; Mrs. Marybeth Buco, first grade teacher in 2nd Ward Elementary, and Mrs. Mary Hoffman, second grade teacher in Heights Elementary.

ATTACHMENT K

Child care Services program combines theory, experience

A tuning-in ceremony was held recently at Highlands Senior High School.

Twenty-three junior and senior girls participated.

Each received a tunic, a pin and an assignment in some field of child care.

Several were sent to elementary schools in Highlands School District. Others were sent to The Bradley Center, Inc., Oakmont.

The ceremony was the climax of a Child Care Services program developed during the 1973-74 school year by Carol Naptes, a home economics teacher and program instructor.

She resides in 1826 Alcoa Drive, Arnold.

All ceremony participants, plus 30 others, are affiliated with the Highlands chapter of FHA-HERO, a national organization whose members and efforts are being recognized this week, Feb. 9 through 15.

The FHA — Future Homemakers of America — has been organized since 1945. There are 11,000 chapters throughout the country.

HERO — Home Economics Related Occupations — also organized on a national scale, is relatively new to the school club scene.

It has been in existence just about four years.

The useful aspect of home economics is emphasized through the FHA, and the gainful, work aspect of home economics, through HERO.

The latter is of particular benefit to students enrolled in the Child Care Services program at Highlands Senior High School.

That program is the most recent of seven in the cooperative vocational education curriculum at the high school.

Others are distributive education, business, home economics foods, health occupations, home economics clothing and diversified occupations education.

Students enrolled in any of the programs attend classes at the high school half a day and complete outside work assignments, called practicums, the other half.

For example, a student who chooses health occupations may during the junior year, receive clinical experience by spending time in a nursing home or in a hospital.

During the senior year the student may work in the office of a doctor or a dentist to acquire necessary work experience.

An interest in home economics foods may find a student working in a drive-in restaurant, and in home economics clothing, in a fabric department or a retail clothing store.

The Child Care Service option requires that enrollees spend time in a related area.

To determine the availability of suitable practicum locations, Carol contacted principals in elementary schools within Highlands School District. Approval was given at Fawn and Prospect elementary schools, also at The Bradley Center, Inc., Oakmont.

Those in charge at Highlands Community Day Care Center thought the program idea an admirable one, but Carol says there was no need for Child Care Services students there.

It had taken four years for the idea to develop to that point.

"People had been calling the school, requesting names of competent babysitters," Carol recalls. "I asked students in my classes whether any would be interested, then I interviewed the respondents, made the selections and offered callers two or three names.

"I began thinking that perhaps we might capitalize on that interest," she says.

Child Development and Looking toward Parenthood is the title of an elective course offered in the home economics curriculum.

That served as the basis for development of the program, if development were feasible.

"To determine whether there actually was a need for such a program through which competent child care workers could be trained, Carol prepared and distributed 100 questionnaires to residents in Highlands School District.

A decision to go ahead with the program prompted her to look into vocational-technical schools across the country that had instituted similar efforts. She adapted those ideas to meet her needs.

Research was done and a curriculum was developed while she completed work for a master degree in that field at Indiana University of Pennsylvania.

The first year, 1973-74, course offerings enticed seven girls, all seniors, to enroll.

There was no opportunity to engage in outside practicums, but each of the seven received experience by assisting in the nursery school at Highlands.

Each planned and presented material suitable to youngsters in that age group.

After high school graduation last year, Carol kept a record of the girls' activities.

Four enrolled in college, one worked for a time at the same job she had while in high school, one married and one moved from the valley.

One of the college students is Jill Diller, a daughter of Mr. and Mrs. John Diller, 1436 Fourth Ave., Natrona Heights.

She is a pedology student at Northside, Pittsburgh, Campus of Allegheny County Community College.

Pedology is the science and study of the life and development of children.

In the two-year program, Jill will receive an associate degree when she graduates. She will be qualified to assist in a classroom, day care center or orphanage, but she says she will not be qualified to handle such a job by herself.

Impetus for enrolling in pedology was provided by the Child Care Services program at Highlands, Jill says.

"I had a full-time babysitting job the summer before my senior year, and I thought I might like to take distributive education.

"I could go to school half a day and work half a day. Then I heard about Miss Naptes' program. I talked to her and decided to enroll. Ever since I was in seventh grade, I've been interested in child care.

Course requirements at the college also include field work. Jill travels every Thursday to Oakland Children's Center where she student teaches.

She carries a full course load three days a week. Included are psychology and child development, which she says isn't difficult because of her exposure to the subject in high school.

A seminar course taught the first year has been retained by Carol, but there have been a number of alterations in the curriculum, which she intends to modify further for next year.

"It's almost like a college-level program," she says, enumerating nine offerings in terms of units for study.

2— Thursday, February 13, 1975 — Valley News Dispatch, New Kensington, Taren

Dedication prevails

Despite yesterday's snow, 75 of 82 scheduled speakers participated in Highlands ninth annual Career Day program. Among the participants was Ida Marie Leoni, speech therapist for Allegheny Intermediate Unit III, who spoke on speech hearing clinician work in the elementary grades. John I. Williams of PPG Industries, chairman, commended the speakers for attending an event they couldn't be sure would be held because of the 4 to 5 inch snow. "This proves how important business and industry views this program," he said.

ATTACHMENT K

Highlands Jr Hi-Lites

VOL. 1 NO. 4 HIGHLANDS JUNIOR HIGH SCHOOL FEBRUARY, 1975

•••

FIELD TRIP

Sixty junior high Spanish students attended the performance of Ballet Folklorico at Heinz Hall on February 9th. The folk dancers appeared in colorful native costumes and did traditional dances from various Spanish speaking countries.

The entire capacity crowd enjoyed the event immensely. The Spanish department wishes to thank Mr. Romito for his assistance.

CAREER DAY

Approximately 75 people representing a wide variety of careers were guest speakers at Career Day on February 12, 1975. The program was a joint effort of the Highlands School District and the Chamber of Commerce.

The morning was divided into two 55 minute sessions. Each student was given his choice of two occupations that interested him.

Special thanks to Mrs. Irene Ravigoni of the Chamber of Commerce for her help in organizing the program.

BHQ

CAREER EDUCATION —

At a recent meeting of the Highlands Career Education Planning Committee, Mrs. Jane Robertson, BHQ (Baldwin, Highlands, Quaker Valley) Coordinator for Allegheny Intermediate Unit 3, disclosed that career education card files had been distributed to teachers in the Highlands School District, in grades 3 and 6. The career education card files are to be used by classroom teachers to integrate career knowledge with subject materials. The cards are grouped into subject areas. Each card briefly describes a subject related career which makes it possible for teachers to integrate career education into the daily subject area discussion.

A report was given by Mrs. Irene Ravigoni, Executive Vice President of the Allegheny Valley Chamber of Commerce, concerning the cooperative development of the career card file. Much of the career information was compiled by the Allegheny Valley Chamber of Commerce through local industry, business and individuals.

A report, given by Highlands Vocational Educational Guidance Counselor Michael Davidek, disclosed that fifteen hundred students had been counseled in vocational careers and that each 10th grade student and parents received information concerning the Forbes Road East Area Vocational-Technical School career preparation offerings. All 10th grade students were also given the opportunity of filling out vocational-technical survey forms to determine their interest. Mr. Davidek also reported that the Career Resource Center in the Junior High School was opened January 6, 1975.

Mr. Fred Thickey, sixth grade teacher at the Riverview Elementary School and elementary Career Education representative, described activities in Career Education in the elementary area. Mr. Thickey stated that to date elementary teachers have not had ample opportunity to use the career education file cards.

Mrs. Martha Kuhn, Career Education representative, reported in the absence of Mrs. Patricia Rumbaugh on several activities involving secondary teachers and students in Career Education. Mrs. Kuhn reported that Mrs. Marcia Watson, home economics teacher in the Junior High School took her classes to Franco Beauty Academy for a field trip on cosmetology and grooming.

The ninth grade social studies teachers have planned units using the Career Resource Center for specific individual investigations.

Mrs. Roberta Malobicky, a tenth grade teacher, emphasized career offerings in her business classes and in the near future is taking her students on a field trip to investigate various jobs and their availability.

An eleventh grade teacher, Mr. Donald Sydlik, in his American history classes takes ten or fifteen minutes to detail any career which arises within the framework of the lesson. Printing and other newspaper jobs, woodworking, cabinet making, jobs in small business compared to opportunities in big business are examples.

A twelfth grade teacher, Mrs. Dorothy Gestner uses role playing techniques in a crime unit. Mock jury trials are held by students. She also uses an application form from local industries to teach students how to properly complete the form and present themselves for a job in the most positive way.

Mr. Patsy Guzzi's programming in vocational-technical programs is continuing on a daily basis as is Mr. Philip Pagliarulo's and Mr. Michael Carlson's in Distributive Education.

Mr. Chester Gill has a group of 25 students in Diversified Occupations Education (DOE). As Job Placement Coordinator, Mr. Gill offers the key to a sound program of placement for vocational students. Job placement is a function not assumed by most schools in the nation.

A new service in which Highlands participates is "The CAPS System" — Computer Assisted Placement Services. CAPS is a method of providing Pennsylvania employers with name, address, and other contact information about the thousands of occupational program graduates who are available for employment each year.

James Podrasky and Michael Kaniecki, students at the Senior High School reported on participation in a television production. Mrs. Paula Wiedl's speech class engaged in the entire student production of the television program, "Shoebox", which is carried over community television on channel 3.

James and Michael reported that the students were responsible for script writing, casting, audio production, camera work, floor management, and program direction. The students stated that this opportunity gave them experience in the working part of television production. Many elementary and secondary students are involved in this TV production project. They termed it a very valuable and rewarding career experience.

The meeting concluded with a brief discussion by Mrs. Ravigoni concerning the arrangements for the annual Highlands Career Day.

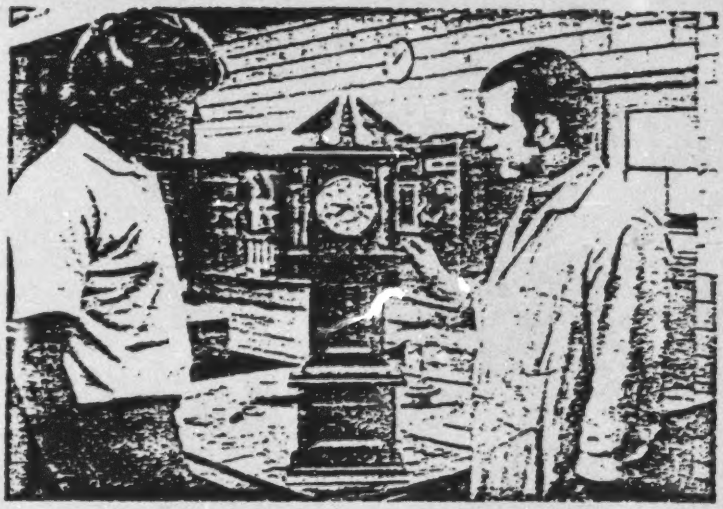
ATTACHMENT K

Progress In Practical Arts

The traditional programs and Home Economics are rapidly changing in Baldwin High School. These changes have come about in recent years due to an increased emphasis on vocational programs and a concern with providing students with saleable skills when they complete high school.

The Home Economics program contains two major areas of emphasis. Useful Home Economics is one of the areas and includes courses that are family centered and provide skills needed by the homemaker. Gainful Home Economics is the second area of emphasis and provides occupational type skills to the student. If a learner wishes to delve into topics which lead to better home living, he can choose from subjects such as Consumerism, Housing and Home Furnishings, Looking Toward Parenthood, Foods and Nutrition, Clothing, and Tailoring. For assistance in preparing for a career, the options are Child Care and Food Service which lead to entry level jobs in those fields and job experience during the senior year. An additional nursery school has been added to the Child Care program at Baldwin in the afternoon to take care of the increased number of students interested in this course. With this addition to the program, more students from the community can enroll for pre-school experiences.

Industrial Arts provides training in three primary occupational areas and a number of classes in crafts. The Industrial Materials courses gives learners experiences in wood, metals, plastics, house construction, wax, and career information. Power technology offers experiences in electronics, combustion engines and work experience on automobile engines. Visual communications has options in drafting, graphic arts, and production.



George Wentz, Baldwin High School Senior on the left, displaying his craftmanship to Mr. Arthur Mohall, Industrial Arts Teacher. George built his clock as a project in Industrial Materials in the High School.

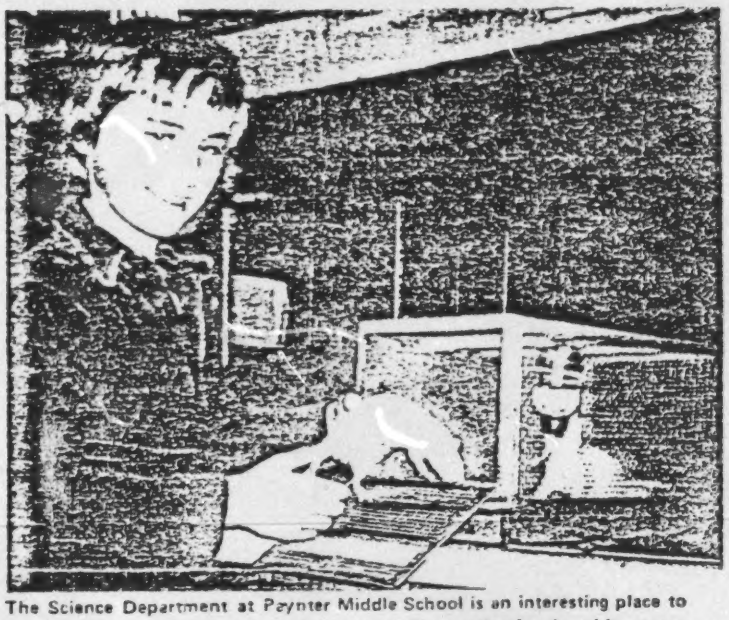
Learning printing skills is a popular vocational program at Baldwin High Schools. Left is Dominick DeSensi making a dry point etching, while Ken Bladesberger center, and John Patterson, right provide verbal assistance.

The greatest influx of students has been in the Crafts classes. Here students are given an opportunity to be creative in many mediums such as leather, glass, metals, wood, and ceramics. They are gaining hobby and vocational skills.

All the practical arts experiences are open to both boys and girls and provide lasting foundations to vocational and avocational living.

ACTIVITIES IN YOUR SCHOOLS

Science

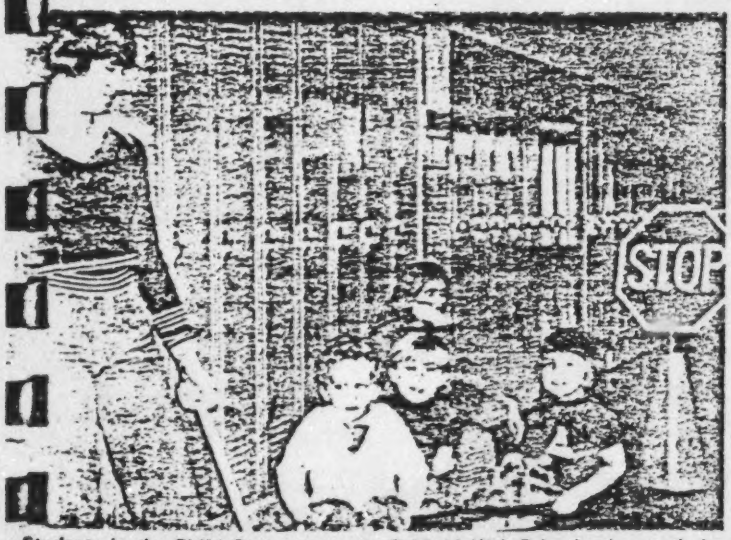


The Science Department at Paynter Middle School is an interesting place to work and learn. Greg Smith, eighth grader, enjoys caring for the white rats as a part of a research project in Science.

CAREERS

Mr. W. Holmes isler of the Allegheny County Election Bureau is telling Mrs. Pat Klein's 5th grade class in Skyline School about the operations of his office.

Child Care



Students in the Child Care program in Baldwin High School gain practical experience in the nursery operated by the Home Economics Department. Bozak is shown providing the power on the simulated highway in the hall side the nursery. Traffic in tricycles and wagons is heavy here during play periods for these youngsters.

Crafts

You will find many girls learning to use tools in crafts classes in Baldwin High School. Debbie Ackerman, a senior is seen carving out a salad bowl from a solid block of wood.

ATTACHMENT K

Baldwin-Whitehall holds career fair

BALDWIN-WHITEHALL—The Secondary School Counselors are planning a Career Fair for next Tuesday at 7 p.m.

The fair will be for students and for parents of students in grades 9-12.

At Whitehall Intermediate School, Mr. Antis and Miss Caserta will be making arrangements for their students. At Wallace Intermediate School, Mrs. Hrutkey and Mr. Mazzacco will take charge. The high school counselors involved in the project are Mr. Vulcan and Mrs. Cingel (11th grade) and Mr. DiGiulio and Mrs. Miserak (12th grade).

PLANNING FOR THIS Career Fair includes passing out a questionnaire to all students in grades 9-12. The students were to indicate their preferenc for their area of career interest. From this information, the counselors devised a program to include the most frequently requested areas. Colleges, business and vocational schools, tradesmen and labor representatives will be present at the fair to provide first hand information to students and parents.

The secondary school counselors invite all interested families to reserve the night of April 29 for the Baldwin Career Fair.

Career Fair is Planned

The Baldwin-Whitehall Secondary School Counselors are planning a Career Fair for April 29, 1975 at 7:00 P.M. This Fair will be for students and parents of students in grades 9 - 12.

At Whitehall Intermediate school Mr. Antis and Miss Caserta will be making arrangements for their students. While at Wallace Intermediate School, Mrs. Hrutkey and Mr. Mazzocco will take charge. The High School Counselors involved in this project are Mr. Vulcano and Mrs. Cingel (11th grade) and Mr. DiGiulio and Mrs. Mizerak (12th grade).

Planning for this Career Fair will involve a questionnaire given to all students grades 9 - 12 to indicate their preferences for the areas of interest in careers. From this, counselors will devise a program to include the most requested areas. Colleges, Business and vocational schools, tradesmen and representatives of the labor market will be present at this fair to provide first hand information to students and their parents.

The Secondary School Counselors invites all interested families to reserve the night of April 29, for the Baldwin Career Fair.

Highlands jr Hi-Lites

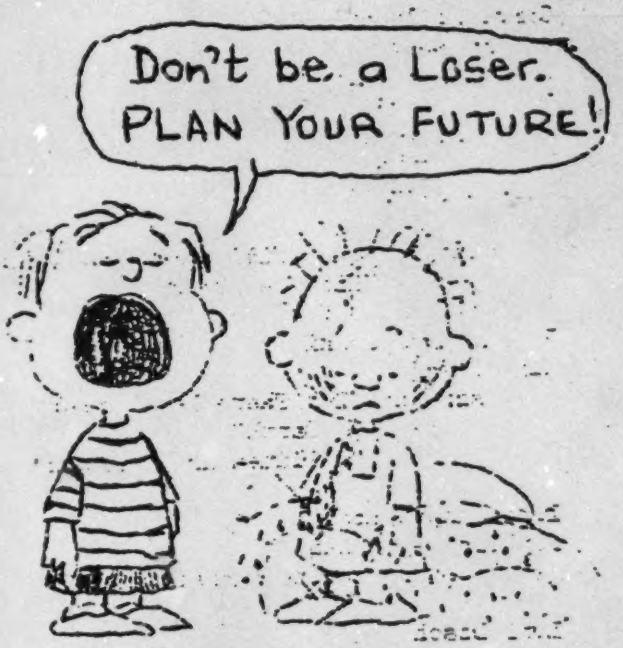
CRC

WHAT IS A CRC?

A Career Resource Center opened officially on January 6, 1975 in Highlands Junior High. The school district now has centers in all three secondary buildings. The CRC's as they are commonly known are designed to assist students in career planning and decision-making. Currently the CRC's are being financed with federal funds. The CRC's collect, evaluate, and disseminate career information on a variety of jobs.

OPERATING METHODS

Career education for each student will be implemented as a total school function and not just a function of the guidance department. The career resource specialist along with the counselors and teachers help students work toward best possible utilization of materials in the exploration and orientation of carrers. The centers are also available to teachers as resources for classroom presentation and subject tie-in. The center is staffed by Mrs. Manning in the library conference room Monday, Wednesday, and Friday from 10:00 to 2:30.



CONTEST WINNERS

The winners of the "CHRISTMAS" word contest were Sandy Morrell with 139 words and Pam Saylor with 145 words. Twenty-eight entries were turned in. Miss Derbaum commends the participants for the variety of words, not knowing many of them herself.

The newspaper club enjoyed spon-

ACCESSION NUMBER: VT102533

PUBLICATION DATE: 16JUN75

TITLE: CURRICULUM FOR OCCUPATIONAL EDUCATION. FINAL REPORT.

PERSONAL AUTHOR: LUNDELL, WILLIAM R.

DESCRIPTOR: *CURRICULUM DEVELOPMENT; *VOCATIONAL EDUCATION; *PROGRAM DESCRIPTIONS; *TEACHER DEVELOPED MATERIALS; TASK ANALYSIS

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 17P.

ABSTRACT: THIS REPORT DESCRIBES A PROJECT IN WHICH COMPETENCY-BASED CURRICULUM GUIDES WERE CONSTRUCTED AND DEVELOPED BY INSTRUCTORS IN THEIR OCCUPATIONAL AREAS. THE MODEL FOR THE GUIDES IS BASED ON STUDENT OUTCOMES FOR EACH TOPIC OF EVERY INSTRUCTIONAL UNIT. THESE OUTCOMES WERE ARRIVED AT BY USING THE PERFORMANCE PROFILES DEVELOPED FROM TASK ANALYSES. EACH UNIT IDENTIFIED SPECIFIC RESOURCES AND A SUGGESTED METHOD OF INSTRUCTORS WAS INCLUDED IN EACH UNIT. THE COURSES WERE THEN FIELD TESTED TO VALIDATE THE RELIABILITY OF THE GUIDE PROCESS AND CONTENT, AND THE CURRICULUM WAS EVALUATED BY BOTH STUDENTS AND TEACHERS IN TERMS OF STUDENT OUTCOMES. SEVENTY-NINE COURSES WERE OFFERED WITH 769 DIFFERENT STUDENTS BEING SERVED WITHIN THE SCHOOL YEAR 1974-75. ONE HUNDRED AND TWENTY-FOUR COURSE GUIDES HAVE BEEN COMPLETED. (AUTHOR/LJ)

INSTITUTION NAME: MINNEAPOLIS PUBLIC SCHOOLS, MINN.

SPONSORING AGENCY NAME: MINNESOTA STATE DEPT. OF EDUCATION, ST. PAUL. DIV. OF VOCATIONAL AND TECHNICAL EDUCATION.

102533

FINAL REPORT

4-D-75

CURRICULUM FOR OCCUPATIONAL EDUCATION

Conducted Using Grant Awarded by
Division of Vocational-Technical Education
Minnesota Department of Education
Under Part C/D of Public Law 90-576

William R. Lundell
Special School District #1
Minneapolis Public Schools
807 N.E. Broadway
Minneapolis, Mn 55413
Department of Vocational, Technical and
Industrial Education

June 16, 1975

VT 102 533

FINAL REPORT

4-D-75

CURRICULUM FOR OCCUPATIONAL EDUCATION

Research and Development Project
in Career Education

Conducted Using Grant Awarded by
Division of Vocational-Technical Education
Minnesota Department of Education
Under Part C/D of Public Law 90-576

The project reported herein was performed pursuant to a grant from the Division of Vocational-Technical Education, Minnesota Department of Education. Grantees undertaking such projects under Division sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated, therefore, do not necessarily represent official Division position or policy.

William R. Lundell
Special School District #1
Minneapolis Public Schools
807 N.E. Broadway
Minneapolis, Mn 55413
Department of Vocational, Technical and
Industrial Education

June 16, 1975

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SUMMARY OF THE REPORT

Time Period: Inclusive time period for Phase I of this five-year program in which EPDA Part D funds (participating) were used is from July 1, 1974, through June 30, 1976.

Goals and Objectives: The goals and objectives of the occupational curriculum project address themselves to preparing young men and women for a wide array of job opportunities within the occupational area of the students' choice, igniting in them a useful and marketable skill upon graduating from high school, stressing relevance, responsibility, opportunity and security.

Procedures Followed:

Curriculum Guides

Competency based guides (see Attachment B) were constructed and developed by instructors exemplifying expertise within the occupational cluster they teach. The model for the guides is based on student outcomes for each topic of every instructional unit. These outcomes were arrived at by using the performance profiles (see Attachment C) developed from task analyses (see Attachment A). Each unit identified specific resources that helped the teacher teach the outcomes. A suggested method of instruction was included in each unit.

Field Testing

Courses developed by instructors were field tested in at least two schools to validate the reliability of the guide process and content. Some guides and some programs were rejected on the basis of course content, manpower need and student interest. The curriculum was evaluated by both students and teachers to determine if the student outcomes were actually taught and learned. (see Attachments D and D2)

Results and Accomplishments: To date, 66 occupations (see Attachment I) have been made available to students within the eight occupational clusters of Business & Office, Communication, Construction, Hospitality, Manufacturing, Marketing for Distribution and Transportation. Seventy-nine courses were offered with 769 different students served within the school year 1974-75. One hundred and twenty-four course guides have been completed. The results of each identified skill taught were rated and formally communicated to the student, school administration, parent and the Department of Vocational-Technical Education, visa via, the "Performance Profile" enriching accountability.

Evaluation: The consensus of those involved in the "Curriculum for Occupational Education," including teachers, students,

administrators, prospective employers, counselors, advisory groups and supportive staff was that this approach to educating today's youth for existing and forthcoming jobs is both right and positive.

Instructors involved developed curriculum guides within each of the eight clusters containing the following components:

1. Student Outcomes
2. Instructional Resources
3. Instructional Methods

A cross-check method of curriculum guide evaluation was used based on what was taught against what the student learned. A unit by unit process evaluation was completed by the student, teacher, and reviewed by the curriculum consultant. (see Attachments F and G)

Conclusions and Recommendations:

All things not being equal, the conclusion of this summary is that the objectives set forth in the proposal, "Curriculum for Occupational Education," have more than met their goal. This project has had great moral support for its continuance from diverse leaders in business, industry and education.

BODY OF THE REPORT

Problem and Purpose:

There is a need for occupational curriculum within the Minneapolis Public Schools and throughout the State of Minnesota which will prepare students for employment in a systematic and planful manner. This curriculum must address itself to preparing young people for a wide array of job opportunities within the occupational area of the student's choice and which will prevent the student from being trapped in the educational straitjacket of having just one, possibly soon to be, obsolete skill.

The need to prepare students with up-to-date Vocational Education, geared to occupational opportunity, is clearly evident in the "Minnesota Shortage Occupation Study." This study identified 49 occupational areas which do not require a four-year college degree. Of all the job openings in these occupations, 50%-80% are listed as "hard to fill." This is occurring at a time of increasing unemployment, especially in the 18-25-year-old range.

Most school districts have developed occupational programs. However, they are usually developed around the expertise of the teacher, and emphasis is placed on the "how to teach" and often neglects the "what to teach" as determined by the

requirements of business and industry. As a result, many students find it difficult to determine a meaningful relationship between what they are being taught, both academically and vocationally, and the type of occupational preparation they anticipate they will need when they leave the educational setting. This is true not only for those who drop out of the educational system but also for those who remain and graduate from high school.

To fulfill the need of bringing the "how to teach" and the "what to teach" together, so students will be educationally prepared for a number of occupational options, is the purpose of this program.

Description: Historically, disciplines within Vocational Education have been responsible for preparing students for occupations. In contrast, this curriculum approach utilizes all educational disciplines, vocational or academic, that can assist in the occupational preparation of the student. This curriculum approach focuses on student outcomes as identified by occupational need, and these outcomes are not always the sole responsibility of only one discipline. Therefore, this curriculum approach is an interdisciplinary approach within Vocational Education as well as within all other areas of education.

The first phase of this program developed a competency based interdisciplinary curriculum within Vocational Education. The second phase, starting the school year 1975-76, will incorporate the academic areas as their input applies to the various occupations.

In this first phase, task analyses were obtained, skills to be learned were identified and a competency based curriculum was written.

This curriculum approach differs from traditional curriculum in the following ways:

1. It is based on a systematically conducted task analysis.
2. It identifies to students, parents and administrators the actual skills a student will learn.
3. It formally communicates what the student has learned skill by skill.
4. It realistically prepares students for actual occupational opportunities.

This curriculum designed around student outcomes, the "what to teach," is in a format that is transportable and is available to all school districts in the State of Minnesota.

Description of Project Design:

Accountability Tool

From a task analysis, a "performance profile" was developed. The tasks from the task analysis were grouped to make occupational skills, and the skills were recorded on the performance profile. The performance profile serves as an accountability tool to whoever is interested in the skills received by the student, i.e., student, parent, administrator, potential employer.

Competency Based Curriculum

The skills identified on the performance profile were identified as instructional units in the curriculum guide. Under each unit, the tasks the student must learn were identified as student outcomes. Each unit identified specific resources which helped the teacher teach the outcomes. A suggested method of instruction was included in each unit.

Field Testing

All competency based guides developed were field tested to determine whether they were within the framework of time specified for each course, achievable skills, necessary equipment and facilities.

Administrative Structure

Project Director

Consultant in Industrial Education

Consultant in Business and Distributive Education

Consultant in Home Economics Education

Consultant in Trade and Industrial Education

Teacher on Special Assignment

Industrial Education — Advisory committee for transportation, manufacturing, communication and construction

Business and Distributive Education — Business and office occupations advisory committee and Distributive Education advisory committee

Home Economics Education — Food services advisory committee and hospitality and recreation advisory committee

Methods and Materials

1. Teacher in-service workshops were conducted on:

   A. How to develop performance profiles.

   B. How to write curriculum guides.

   C. Pilot testing guides.

   D. Implementation of the curriculum as a course offering.

2. A complete promotional program was initiated prior to offering the program on a city-wide basis through the use of "All City Campus" brochures, secondary center green sheets and the multimedia presentation of the occupational educational program in Minneapolis.
3. Samples of materials from publishers and business and industry were obtained to help the curriculum writers identify teaching materials.
4. Teaching materials not on hand but required to teach the student outcomes are in a static state of being purchased.
5. All materials developed will be produced and made available to other school districts.

Participants

By the end of the school year 1974-75, training for 66 occupations was available. Seven hundred sixty-nine different students at the secondary level were involved. The students came from each high school in the Minneapolis school system, and their enthusiastic participation indicated their desire to enroll and follow through in a given occupational training program.

Personnel

William R. Lundell, Ph.D., Project Director

Birth Date - 7-8-28

Social Security No. - 476-20-4313

Time Committed to this Project - 70%

Time Devoted to other Projects - 30%

Results and Accomplishments: One important and encouraging resultant of this year's project, and worthy to note, is that new occupations and courses have emerged in the program, and projected student enrollment for these courses is on the increase to provide the best possible occupational education. More teachers have seen the need to want to become vocationally certified. A spectrum of schools has received modern equipment to help the instructor teach up-to-date skills. There has been greater articulation between disciplines, secondary and postsecondary schools, junior colleges and between school districts.

Evaluation: Up-to-date Vocational Education is brought alive through the Occupational Education Curriculum Project of Minneapolis. Students are finding a real and meaningful relationship between what existed within the confines of the traditional classroom and the world of work. Broadening the student's base and conception of the requirements

of business and industry helps the student to synthesize and assimilate what he might want to be and what he actually can be.

Teachers, students, parents, potential employers and school administrators have responded quite favorably to the Occupational Education Curriculum Project, adding a new dimension and color to the ideology of competency based norms and accountability.

1. The evaluation of this program consisted of two parts. A unit by unit evaluation made by the student involved indicating the degree of skill he believes he has obtained in relation to each student outcome identified in the curriculum format.
2. The instructors involved in the pilot testing of the program evaluated every student outcome unit by unit. The unit by unit evaluations, both by the student and the teachers, made up a process evaluation.

As a result of the process evaluation, the curriculum was changed and adapted where needed. After being corrected, it comprises the total vocational curriculum as it pertains to each occupation for which training is provided. The

ongoing utilization of this curriculum and this approach to teaching for occupational education was through participating funds by the financial assistance of the local school district.

Conclusions and Recommendations: Implications:

At a time of decreasing student enrollment, budgets being cut and programs diminishing as a result of both, it is economically and feasibly important to operate under the consortium of occupational education curriculum for the following reasons, having a variety of implications for the future, which are listed below:

1. Provides students with a meaningful credential when applying for a job.
2. Serves more levels of students both horizontally and vertically.
3. Makes for more efficient use of equipment and facilities.
4. Better utilization of instructors' ability.
5. Provides for a constructive change in the students' program.
6. Builds in accountability.
7. Ignites and motivates students through more available options and career opportunities.

8. Promotes articulation not only between secondary and postsecondary institutions but also between disciplines.

WRL/MGM:ho

EPDA PARTICIPATING FUNDS BUDGET

Title of Project: Curriculum for Occupational Education

Name of Project Director: William R. Lundell

Applicant Organization: Minneapolis Public Schools,
Special School District #1

Proposed Beginning and Ending Dates: July 1, 1974, to June 30, 1975

	EPDA	LOCAL SCHOOL DISTRICT
Director		$ 1,750
Staff (consultants)		7,250
Staff (teachers)	$ 6,000	8,250
Clerical Staff		3,500
Consultants (and travel)	500	
Office Supplies Publishing and Duplicating	2,550	
Sample Curriculum Material	950	2,500
Totals	$10,000	$ 23,250
TOTAL COSTS 1974-75		$ 33,250

ACCESSION NUMBER: VT102535

PUBLICATION DATE: 01JUL75

TITLE: EDUCATIONAL ADMINISTRATION PROGRAM FOR LOCAL ADMINISTRATORS. FINAL STATUS REPORT.

DESCRIPTOR: *ADMINISTRATOR EDUCATION; *VOCATIONAL EDUCATION; *INTERNSHIP PROGRAMS; PROGRAM DESCRIPTIONS; RURAL AREAS

IDENTIFIER: MINNESOTA

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 6P.

ABSTRACT: THIS REPORT DOCUMENTS THE EFFORTS OF A PROJECT TO RESOLVE THE PROBLEM OF THE GROWING SHORTAGE OF QUALIFIED ADMINISTRATORS FOR SECONDARY AND POSTSECONDARY VOCATIONAL PROGRAMS IN RURAL AND OUTSTATE AREAS OF MINNESOTA. THE OBJECTIVES OF THE PROGRAM WERE: (1) TO IDENTIFY THE POPULATION TO BE SERVED; (2) TO SELECT HOST SCHOOLS FOR AN INTERNSHIP PROGRAMS; (3) TO UPDATE STAFF; (4) TO UTILIZE COMPETENCY-BASED CURRICULUM; (5) TO DEVELOP INTER-INSTITUTIONAL COOPERATION; AND (6) TO PROVIDE REFERRAL AND PLACEMENT SERVICES. AT THE TIME OF THE REPORT 35-40 STUDENTS ARE ACTIVELY INVOLVED IN THE PROGRAM AND THREE HAVE COMPLETED IT AND ARE IN ADMINISTRATIVE POSITIONS. IN EVALUATING THE PROGRAM, THE PROJECT DIRECTOR, STAFF, AND DIRECTORS OF THE HOST SCHOOLS CONCLUDED THAT THE PROGRAM IS EFFECTIVE, FULFILLS A NEED AND SHOULD BE CONTINUED. (NJ)

INSTITUTION NAME: MANKATO STATE COLL., MINN. CENTER FOR VOCATIONAL COMPETENCY.

SPONSORING AGENCY NAME: MINNESOTA STATE DEPT. OF EDUCATION, ST. PAUL. DIV. OF VOCATIONAL AND TECHNICAL EDUCATION.

102 535

FINAL STATUS REPORT

5-D-73

Educational Administration
Program for Local Administrators

Research and Development Project
In Career Education

Conducted Using Grant Awarded by
Division of Vocational-Technical Education
Minnesota Department of Education
Under Part C/D of Public Law 90-576

The project reported herein was performed pursuant to a grant from the Division of Vocational-Technical Education, Minnesota Department of Education. Grantees undertaking such projects under Division sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Division position or policy.

Brendan G. Coleman, Project Director
Center for Vocational Competency
Mankato State College
Mankato, MN

July 1, 1975

VT 102 535

ROUTING COVER SHEET
STATE-ADMINISTERED
RESEARCH-DEVELOPMENT-EXEMPLARY PROJECTS

(Optional Interim Use-6-74)

DATE: 9/15/75

SEP 22 1975

FROM: Robert P. Van Tries
State Director, Vocational Education

State: Minnesota

TO : William Lewis
Regional Director, OAE

Region #: V, Chicago

SUBJECT: Forwarding of Document: Check one:

- ☐ Newly Approved Proposal
- ☐ Interim Material
- ☒ Final Report

Attached are THREE (3) copies of a document for submission to the USOE in compliance with P.L. 90-576 regulations. The following data apply:

TITLE: Experimental Educational Administration Program for Local Administrators

PRINCIPAL INVESTIGATOR(S)/AUTHOR(S): Brandon G. Coleman

INSTITUTION & LOCATION: Mankato State College, Mankato, MN

PROJECT DURATION: From: 7 (Month) - 73 (Year) to 6 (Month) - 75 (Year)

SOURCE OF FUNDS (complete only for newly approved proposals):

			ESTIMATED CONTINUATION	COST
☐ Part C, Section 131(b):	$ _____ Amount	Charged to FY __	FY __	_____ Amount
☒ Part D, Section 142(d):	$ _____ Amount	Charged to FY __	FY __	_____ Amount
☐ Part B, (Ancillary):	$ _____ Amount	Charged to FY __	FY __	_____ Amount
☐ Other: _____ Source	$ _____ Amount			
☐ Other: _____ Source	$ _____ Amount			

W2L by GMB

DATE: 9/26/75

FROM: William L. Lewis, Region #: V
Regional Director, OAE

TO : Chief, Demonstration Branch, DRD/BOAE/OE
Room 5020, ROB #3, 7th & D Streets, SW.
Washington, D.C. 20202

ATT: Coordinator, State Vocational Research Programs

One (1) copy has been retained and the remaining TWO (2) copies are forwarded

DATE: OCT 1 1975

FROM: Chief, Demonstration Branch, DRD/BOAE/OE

TO : Director, AIM/ARM
Ohio State University
1960 Kenny Road
Columbus, OH 43210

FORWARDED FOR INCORPORATION INTO AIM/ARM

Final Status Report

Educational Administration
Program for Vocational Administrators

1. Time Period covered by report:
June 1, 1974 - June 30, 1975

2. Goals and Objectives of the report:
(A) Resolve problem of growing shortage of qualified administrators for secondary and post-secondary vocational programs in rural and outstate areas of Minnesota.

(B) Specific objectives of the program:
(1) Identify population to be served.
(2) Select host schools for internship program.
(3) Update staff in both vocational center and in Educational Administration program in area of vocational education.
(4) Provide program flexibility through the use of competency-based curriculum.
(5) Develop inter-institutional cooperation between area vocational-technical institutes, vocational centers, and the college.
(6) Provide referral and placement services for all candidates.

3. Procedures followed in Development and Maintenance of Program:
(A) Utilized advisory committees in developing program and in development of competency-based exams.
(B) Developed brochures describing program. This was revised twice.
(C) Program developed to meet Mankato State College's requirement of 51 hours for the M.S. degree alternative plan program.
(D) Program established with 8 courses (24 hours) required in the 51 hour total.
(E) The committees approved the internship as a required course, with a minimum of 90 contact hours. Existing area vocational-technical institutes and vocational centers to serve as hosts.
(F) The plan for the program included the development of competency-based examinations in each of the required courses. Students with experience in any one of the areas would have the option of utilizing this alternative.
(G) Practicing administrators in the field were to be involved as consultants in the basic courses in the program.

(H) Both on-campus and off-campus classes were to be offered to practicing and potential vocational education administrators.

(I) An advisee-advisor program was developed involving each student. Staff members were utilized from both the vocational center and the Educational Administration program.

(J) As the program was being revised during the 1974-75 school term, individual conferences were held with the students involved in the classes being offered and with members of the Advisory Committee.

(K) Approval was granted to the students for the right to transfer 15 hours of credit at the graduate level.

4. Results and Accomplishments:

(A) The program for training administrators for vocational centers and vocational-technical institutes was developed and approved by college officials, the advisory committees, and by the State Board during the 1973-74 academic year. For the 1974-75 school year the focus was centered on the evaluation of the program. Feedback from the students and from the Advisory Committee has been solicited.

(B) Continued visits were made to several of the area vocational-technical institutes and vocational centers in the Mankato State College service area. These visits were made by the Assistant Project Director and members of the Vocational Center and the Educational Administration program at the college. One out-of-state visit was made to the AVTI at Moorhead.

(C) An adequate number of internship centers have been selected. All of the schools have been very willing to cooperate in this phase of the project.

(D) Approximately 35-40 students are still actively involved in the program.

(E) To date three students have completed the program and are now in administrative positions.

(F) Four of the students have now completed the intern program (candidates that have been practicing administrators are waived from this requirement and expected to complete an additional three-hour course). One student is involved in the internship program during the I Summer Session of 1975.

(G) The competency-based examinations have been developed and approved in the required areas of the program. Input and approval was secured from a special advisory committee consisting of the following:

(G) (Cont.)

(1) Frank Kalin, Mankato Area Vocational-Technical Institute
(2) Ray Freund, Faribault Area Vocational-Technical Institute
(3) Don Frederick, Vocational Center Director at Wells
(4) Richard Peterson, Vocational Education Director at Dakota County.

The areas in which the competency-based programs have been developed are:

(1) Public School Administration
(2) Secondary School Supervision
(3) Public School Finance
(4) School Plant Planning
(5) School Personnel Administration
(6) Philosophy and Organization of Vocational Education
(7) Public Relations
(8) School Law
(9) School Business Management
(10) Curriculum in Vocational Education
(11) Organization and Administration of Occupational Experience Programs

At the end of the second year of operation only two students had availed themselves of the competency-based examinations.

(H) The development of the program has resulted in continual cooperation and a closer relationship between the staff members of both programs. A better understanding of each others programs has been a major benefit.

(I) As the need has arisen, referral and placement services have been provided to the students in the program. Of the six graduates, three were already in administrative positions. The remaining three graduates have been placed in administrative roles.

(J) A total of 29 off and on-campus classes were offered during the 1974-75 school year by the Center for Vocational Competency and the Educational Administration program. (11 of these were off campus) These were courses that were either required or listed as electives in the MS degree program in Vocational Administration.

5. Evaluation:
   (A) One meeting of the Advisory Committee has been held this year with time devoted at both meetings for input and evaluation on the part of the advisory committee members. Many constructive suggestions resulted for strengthening the program.
   (B) At the time of the Assistant Project Director's visit to three of the centers and area vocational-technical institutes the following proecedure was utilized:
      (1) The Director and his staff were requested to review the program and make suggestions related to its improvement and general success.
      (2) The Directors of the Centers serving as host schools for the interns were invited to comment on the internship program.
   (C) Through individual conferences the students have been invited to express their satisfaction or dissatisfaction with the program.

6. Conclusions, Implications, and Recommendations:
   (A) The staff members in both the Educational Administration program and the Center for Vocational Competency continue to feel that this is a good program and that a definite need exists in the Mankato State College service area.
   (B) The large number of students that have become involved in the program is a positive indication of the acceptance of the program. (In excess of 50 enrollees with approximately 35 active students.)
   (C) Both the Educational Administration program and the Center for Vocational Competency urge the continued support of the project by the State Department of Public Instruction.

7. Future Implications
   (A) The continuing professionalization process in teaching and administration throughout both our secondary and post-secondary vocational programs dictates the increasing possibility that administrators of vocational programs that are housed in separate facilities may well need to hold valid Superintendency certificates. Such a requirement could affect a number of our Interdistrict Cooperative Centers as well as our Area Vocational-Technical Institutes.

   It is conceivable that professional education organizations that are presently active in the state will support the advanced educational requirements for administrators as a means of ensuring continued browth in administrative ranks as has been the case in the ranks of the teaching staff.

It would appear wise at this time to utilize the expertise gained from the current project to implement a similar program at the sixth-year specialist degree level. Such a program would include the certificate as well as the necessary advanced courses of preparation required for the independent supervision and administration of a separate educational facility. It is the opinion of the members of this project team that such a program is feasible and could be implemented including utilization of a competency-based approach to those portions or aspects of the program that individual candidates appear competent to utilize.

The additional stature to be gained both professionally and personally from the completion of ad advanced Sixth-Year Specialist Degree would reflect well upon vocational-technical education. It would demonstrate once again that the vocational-technical education family has continued to lead the way in providing leadership in education throughout the state. The ramifications of providing such an opportunity to top-flight vocational teachers and administrators are manifold--especially in view of the continuing development of the Interdistrict Cooperative Center and the distinct possibility that such cooperative centers will become deeply involved in providing typically non-vocational experiences and courses to those who cannot attain them in their home school.

The conditions cited in part "C" openly suggest the need for vocational administrators operating both Interdistrict Cooperative Centers and AVTI's to be completely qualified to administer a "School" that offers more than vocational courses. We suggest that now is the time to begin with a select group of prime Sixth-Year Degree candidates for admission to such a competency-based program. Such a program, in our judgment, should incorporate stipends for fellowships as well as internships, competency-based examinations, field work, and course work. Funding would be a necessity and should probably be geared to a five-year project base whereby a select number of candidates are admitted each year and replaced the following year with another "flight" or group of candidates. We do not view this as being a large-scale operation. Perhaps a maximum of 7-10 candidates per year might be admitted under the conditions cited.

ACCESSION NUMBER: VT102538

PUBLICATION DATE: 30JUN75

TITLE: ELEMENTARY CRAFTS PROGRAM (FORMERLY OTHER LADDERS). EXEMPLARY PROJECT. FINAL REPORT.

PERSONAL AUTHOR: RILEY, PETER

DESCRIPTOR: *ELEMENTARY SCHOOL STUDENTS; *EDUCATIONAL ALTERNATIVES; *DEVELOPMENTAL PROGRAMS; *ACADEMIC FAILURE; *SUCCESS FACTORS; HANDICRAFTS; INDIVIDUAL INSTRUCTION; ELEMENTARY EDUCATION

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 6P.

ABSTRACT: THE GOAL OF THE PROJECT REPORTED IN THIS DOCUMENT WAS TO PROVIDE ALTERNATE LEARNING SITUATIONS FOR A TARGET POPULATION OF 35 CHILDREN SELECTED FOR CRAFT EXPERIENCES OF THEIR OWN CHOOSING. THE PROJECT WAS DIRECTED TOWARD ELEMENTARY STUDENTS WHO HAD SUFFERED A HIGH DEGREE OF FAILURE, WITH THE HOPE THAT AN OPPORTUNITY TO SUCCEED MIGHT GIVE THEM AN IMPROVED SELF-IMAGE. TYPES OF CRAFTS AVAILABLE WERE IN WOODWORKING, PHOTOGRAPHY, AND CERAMICS. ABOUT ONE-THIRD OF THE STUDENTS WERE FROM THE SPECIAL EDUCATION CLASS AND THE REMAINDER FROM THE SCHOOL POPULATION OF 300. AGES RANGED FROM 10 TO 15 YEARS. THE CRAFT GROUPS WERE SMALL, WITH THE STUDENTS RECEIVING PERSONAL ATTENTION. THE PROGRAM WAS POPULAR WITH CLASSROOM TEACHERS, STUDENTS, AND PARENTS. RESULTS INDICATE THAT SUCCESS STIMULATED IN THIS MANNER LEADS TO IMPROVED CLASSROOM PERFORMANCE AND THAT A PROGRAM OF THIS NATURE MIGHT WELL BE IMPLEMENTED IN EVERY ELEMENTARY SCHOOL. (AUTHOR/MF)

INSTITUTION NAME: HUSE MEMORIAL SCHOOL, BATH, MAINE.

SPONSORING AGENCY NAME: MAINE STATE DEPT. OF EDUCATIONAL AND CULTURAL SERVICES, AUGUSTA. BUREAU OF VOCATIONAL EDUCATION.; OFFICE OF EDUCATION (DHEW), WASHINGTON, D.C.

102 53

FINAL REPORT

ELEMENTARY CRAFTS PROGRAM
(FORMERLY OTHER LADDERS)

EXEMPLARY PROJECT

CONDUCTED UNDER
PART C OR PART D OF PUBLIC LAW 90-576

PETER RILEY
BATH SCHOOL DEPARTMENT
HUSE MEMORIAL SCHOOL
BATH, MAINE 04530

JUNE 30, 1975

VT 102 538

FINAL REPORT

EXEMPLARY PROJECT

CONDUCTED UNDER
PART C AND PART D OF PUBLIC LAW 90-576

THE PROJECT REPORTED HEREIN WAS PERFORMED PURSUANT TO A GRANT FROM THE BUREAU OF VOCATIONAL EDUCATION, MAINE DEPARTMENT OF EDUCATIONAL AND CULTURAL SERVICES. GRANTEES UNDERTAKING SUCH PROJECTS UNDER STATE DEPARTMENT SPONSORSHIP ARE ENCOURAGED TO EXPRESS FREELY THEIR PROFESSIONAL JUDGMENT IN THE CONDUCT OF THE PROJECT. POINTS OF VIEW OR OPINIONS DO NOT, THEREFORE, NECESSARILY REPRESENT OFFICIAL DEPARTMENT OF EDUCATIONAL & CULTURAL SERVICES POSITION OR POLICY.

PETER RILEY
BATH SCHOOL DEPARTMENT
HUSE MEMORIAL SCHOOL
BATH, MAINE 04530

JUNE 30, 1975

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SUMMARY OF THE REPORT

(A) THE TIME PERIOD COVERED BY THE REPORT IS DIVIDED INTO TWO PERIODS. THE FIRST FROM SEPTEMBER, 1974 - FEBRUARY, 1975 COVERED BY FEDERAL FUNDING. THE REMAINDER, MARCH, 1975 - JUNE, 1975 COVERED BY LOCAL FUNDING.

(B) THE GOALS OF THE PROJECT HAVE BEEN, AND STILL ARE, TO PROVIDE ALTERATIVE LEARNING SITUATIONS FOR 35 TARGET CHILDREN WITH SUCCESS AS THE INCENTIVE.

(C) THE CHILDREN WERE SELECTED BY THE SCHOOLS EVALUATION TEAM WHO RESPONDED TO TEACHER RECOMMENDATION. THEY WERE THEN INTRODUCED TO A SERIES OF CRAFT TYPE EXPERIENCES CHOSEN BY THEM AND DESIGNED TO INSURE THEIR SUCCESS.

(D) THE EVALUATIONAL MATERIAL SUGGESTS CLEARLY THAT SUCCESS STIMULATED IN THIS MANNER TRANSLATES DIRECTLY TO IMPROVED CLASSROOM PERFORMANCE.

(D) THIS YEAR, AS WELL AS THE THREE PRIOR YEARS, SUGGESTS CLEARLY THAT A PROGRAM OF THIS NATURE FALLS VERY COMFORTABLY WITHIN THE PERINETERS OF THE PUBLIC ELEMENTARY SCHOOLS NEEDS.

Body of the Report

THE AREA TO WHICH THIS PROJECT HAS BEEN DIRECTED HAS BEEN TOWARD CHILDREN WITHIN THE ELEMENTARY SYSTEM WHO HAVE SUFFERED A HIGH DEGREE OF FAILURE WITH THE HOPE THAT AN OPPORTUNITY TO SUCCEED, HOWEVER ARTIFICALLY STIMULATED, MIGHT GIVE THEM A RENEWED SELF IMAGE WHICH MIGHT BE TRANSLATED TO THEIR CLASSROOM WORK.

WITH THIS IDEA IN MIND, 35 CHILDREN WERE SELECTED BY THE SCHOOL EVALUATION TEAM. THE PROGRAM IS POPULAR WITH THE CLASSROOM TEACHERS WHO MAKE AS MANY REFERRALS AS THEY WISH SO THE PROBLEM IS NEVER "ARE THEIR ENOUGH", BUT RATHER HOW IT ALL MIGHT BE CARVED DOWN TO WORKABLE SIZE. THE PROJECT IS EQUALLY POPULAR WITH THE CHILDREN WHO OFTEN REFER THEMSELVES TO THE EVALUATION TEAM. BECAUSE OF THIS PRESS OF NUMBERS, THIS YEAR, FOR THE FIRST TIME, WE SPLIT THE YEAR IN HALF AND RAN TWO SESSIONS. THIS OBVIOUSLY INCREASED OUR CONTACT CONSIDERABLY. I DID NOT FEEL, HOWEVER, THAT THERE WAS ANY APPRECIABLE DILUTION OF EXPERIENCE FOR THE CHILD AS, IN A WELL RUN PROGRAM, THE CHILD IS APT TO SUFFER FROM A DEGREE OF OVERKILL IN AN ENTIRE YEAR OF SCHEDULING.

THE SELECTED STUDENTS ARE INTRODUCED TO A MANDATORY DEPARTURE PROJECT WITHIN WHICH ARE MANY OF THE ROUTINES THAT ARE USED IN THEIR EXPERIENCE. AFTER THIS THEY ARE FREE TO CHOOSE WHERE THEY WISH TO GO. IT IS AT THIS POINT THAT I HAVE ARTFULLY PROVIDED THEM WITH THINGS THEY WANT SO BADLY THAT THEY WILL RISK THE POSSIBILITY OF FURTHER FAILURE TO GET THEM. THE NEXT KEY STEP IN THE PROCESS IS TO INSURE THROUGH (1) THE DESIGN OF THE PROJECT AND (2) THROUGH MY OWN SKILL THE SUCCESS OF THE PROJECT. ONCE THIS SIMPLE EXCHANGE HAS HAPPENED THE FIRST TIME THE CLASS IS OFF AND RUNNING, OFTEN WITH THE STUDENT HAVING ELECTED AN ENTIRE SEMESTERS WORK IN ADVANCE. THE PROJECTS FALL LARGELY INTO THE WOODWORK ARE BY STUDENT CHOICE AND NUMBER CARS, BOATS, PLANES AND ALL KINDS OF PERSONAL STORAGE BOXES. THE READER IS REFERRED TO THE DISSEMINATION BOOKLET THAT ACCOMPANIES THIS PROJECT.

ALSO ONGOING IS A PHOTOGRAPHY AND CERAMICS EXPERIENCE. THE PHOTOGRAPHY EXPERIENCE IS ADMINISTERED BY ANOTHER STAFF MEMBER UNDER SEPARATE FUNDING. ABOUT A THIRD OF THE STUDENTS COME FROM THE SPECIAL EDUCATION CLASS AND THE REMAINING TWO THIRDS FROM THE SCHOOL POPULATION OF 300. THE AGES RANGE FROM 10 TO 15 YEARS AND THE SEXES ARE MORE OR LESS EVENLY DISTRIBUTED. THERE IS DIFFERENCE IN THE EXPERIENCE BETWEEN GIRLS AND BOYS AS THE CHILDREN DO NOT CHOOSE IT. THE GROUPS ARE SMALL NUMBERING NO MORE THAN 4 AS I CAN NOT MANAGE THE SUCCESS IDEA WITH MORE. IN OTHER WORDS, THE EXPERIENCE MUST BE MANAGED ON A VERY PERSONAL AND SUPPORTIVE PLANE OR THE CHILD SIMPLY FAILS, UNDOING THE WHOLE IDEA.

THE RESULTS OF THIS PROJECT AND APPROACH HAVE BEEN VERY ENCOURAGING AS THE STUDENTS ARE EVER ANXIOUS TO GET TO "SHOP", THEIR TEACHERS AND PARENTS ENVOY THE INCREASED EXCITEMENT OVER THE SCHOOL PROCESS AND THERE SEEMS TO BE A DIRECT CORRELATION BETWEEN PROJECT INVOLVEMENT AND CLASSROOM PRODUCTION. DUE TO THESE SUCCESSES WE HAVE MANAGED TO MAKE THE STEP FROM FEDERAL TO COMMUNITY FUNDING.

EVALUATION

OVER THE THREE YEAR PERIOD OF THE PROJECT IT HAS BEEN THE INTENT TO PHASE OUT THE INDEPENDENT EVALUATION ROLE SO THAT THIS YEAR THE EVALUATION WAS DONE COMPLETELY AT THE LOCAL LEVEL WITHOUT OUTSIDE ASSISTANCE.

IN THE COLLECTIVE OPINIONS OF TEACHERS, ADMINISTRATORS, SUPPORT STAFF AND PARENTS IT WAS CONCLUDED THAT THE PROGRAM SHOULD CONTINUE AT AN INCREASED LEVEL.

AS A RESULT, THE BATH SCHOOL DEPARTMENT SOUGHT FUNDING INDEPENDENT OF FEDERAL/STATE MONIES TO CONTINUE THE PROJECT FOR THE 1975-76 SCHOOL YEAR WITHOUT ANY PROGRAM CUTBACK. WE WERE SUCCESSFUL!

FROM THE ABOVE I FEEL THAT IT IS SAFE TO CONCLUDE THAT AN ONGOING PROJECT SUCH AS THIS SHOULD BE VERY MUCH PART OF THE ELEMENTARY SCHOOL EXPERIENCE FOR EVERY CHILD, NOT SIMPLE THOSE IN SOME SORT OF EXTREMIS. I AM PLEASED TO NOTE THAT THE CHILDREN CONCLUDE THE SAME THING.

IT HAS ALSO BEEN OUR EXPERIENCE THAT THE PROVISION OF THIS EXPERIENCE IS NOT COST PROHIBITIVE, PARTICULARLY IF THE ADMINISTRATION IS WELL PROGRAMMED AND THE INSTRUCTION IS SUPPORTIVE.

THERE ARE MANY POINTS AT WHICH ACADEMIC SKILLS CAN BE EXERCISED, I.E. MEASUREMENT, PROBLEM SOLVING, AND SPACE SHAPE RELATIONSHIPS WHICH MAKES THE CLASSROOM TEACHERS HOSPITABLE TO THE PROCESS.

I FEEL THAT THE DAY IS NOT FAR AWAY THAT A PROGRAM OF THIS NATURE WILL EXIST IN EVERY ELEMENTARY SCHOOL. THE GOALS OF WHICH WILL BE THE INTRODUCTION OF THE IDEA THAT A JOB WELL DONE IS A SATISFYING EXPERIENCE, PARTICULARLY AS OUR GENERALIZED EDUCATION GOALS UP THROUGH COLLEGE ARE SWUNG TOWARD VOCATIONAL INSTRUCTION.

Peter Riley
SIGNATURE OF PROJECT DIRECTOR

June 27, 1975
DATE

ACCESSION NUMBER: VT102544

PUBLICATION DATE: 29MAY75

TITLE: A CAREER EDUCATION MINI COURSE IN HEALTH OCCUPATIONS. A MINI-GRANT PROPOSAL. FINAL REPORT.

PERSONAL AUTHOR: DENISON, DAVID H.; ELLIOT, SAMUAL W.

DESCRIPTOR: *HEALTH OCCUPATIONS EDUCATION; SECONDARY EDUCATION; FIELD TRIPS; *NURSES AIDES; TESTS; *TEACHING GUIDES; *PROGRAM DESCRIPTIONS; CAREER EDUCATION; DEVELOPMENTAL PROGRAMS

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 14P.

ABSTRACT: A MINICOURSE IN HEALTH OCCUPATIONS WAS IMPLEMENTED AS AN EXEMPLARY PROJECT IN CAREER EDUCATION FROM NOVEMBER 1974 TO JANUARY 1975. THE GOAL OF THE PROGRAM WAS TO ORIENT STUDENTS TO HEALTH CAREERS AND TO PROVIDE THEM WITH BASIC CARE SKILLS. A REGISTERED NURSE PROVIDED CLASSROOM INSTRUCTION AND COORDINATED TRIPS TO LOCAL HEALTH CARE UNITS. ALTHOUGH THE EMPHASIS OF THE PROGRAM WAS ON NURSING CAREERS, THE STUDENTS ALSO LEARNED ABOUT THE OCCUPATIONS OF LAB TECHNICIAN, DENTAL TECHNICIAN, X-RAY TECHNICIAN, DIET TECHNICIAN, AND PHYSICAL THERAPIST. THE STUDENTS WERE EVALUATED BY A COMPREHENSIVE FINAL EXAMINATION WHICH IS INCLUDED IN THE APPENDIX OF THE REPORT. ALSO INCLUDED ARE THE COURSE OUTLINE, A LIST OF PERFORMANCE TASKS, AND THE INSTRUCTOR'S REPORT. (NJ)

INSTITUTION NAME: TELSTAR REGIONAL HIGH SCHOOL, BETHEL, MAINE.

SPONSORING AGENCY NAME: MAINE STATE DEPT. OF EDUCATIONAL AND CULTURAL SERVICES, AUGUSTA. BUREAU OF VOCATIONAL EDUCATION.; OFFICE OF EDUCATION (DHEW), WASHINGTON, D.C.

102 544

FINAL REPORT

A CAREER EDUCATION MINI COURSE IN HEALTH OCCUPATIONS

A MINI-GRANT PROPOSAL

Conducted under
Part C or Part D
of Public Law 90 576

Submitted by:

David H. Denison
Coordinator, Cooperative Education

and

Samuel W. Elliot
Director, Counseling Center
Telstar Regional High School
Bethel, Maine 04217

May 29, 1975

VT 102 544

FINAL REPORT

Research and Development Project
or Exemplary Project

Conducted Under
Part C and Part D of Public Law 90 576

The Project reported herein was performed pursuant to a grant from the Bureau of Vocational Education, Maine Department of Educational and Cultural Services. Grantees undertaking such projects under State department sponsorship are encouraged to express freely their professional judgement in the conduct of the project. Points of view or opinions do not, therefore, necessarily represent official Department of Educational & Cultural Services position or policy.

David H. Denison
Coordinator, Cooperative Education
Telstar Regional High School
Bethel, Maine 04217

May 29, 1975

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Summary of Report

The mini course in Health Occupations started on November 12, 1974 and was completed on January 9, 1975. The goal of the program was to orient students in health careers and to provide those students with basic care skills. This was done by hiring a Registered Nurse to instruct the students in a classroom setting and to coordinate trips to local health care units. The results of the program indicate a clearer perception on the part of the students of the various occupations in the health career field, and familiarity with the basic skills involved in patient care. The program was a success, but due to scheduling difficulties did not involve as many students as orginally planned.

Body of the Report

The intention of the Health Careers Program was to give students greater insight and awareness into various health occupations. A number of students in the rural district were expressing interest in health careers, but often with extremely limited perceptions and experience regarding these occupations. This program was an attempt to meet the needs of these students by familiarizing them with basic medical care procedures and exposing them to actual work environments.

The objectives of the program were as follows:

(1) to implement a career awareness program for 12 junior and senior high school students interested in health occupations.

(2) to orient students to six health careers in which there are local employment possibilities and to provide these students with basic care skills.

(3) to hire a registered nurse to coordinate the program and utilize resource people as instructors in each of the following health occupations: nursing, x ray, medical labratory, physical therapy, occupational therapy, and dietary service.

(4) to operate the program for two hours a day for five weeks after school hours and to have five weekly seminars of two hours each for those students placed in health occupations following the mini course.

Some of the students orignially interested in the program were unable to participate due to scheduling conflicts. To eliminate some of the conflict, the program was offered immediately after school, but due to transportation problems, and involvement in other activities, some students were still not able to participate. A total of 11 students were enrolled in the course, because of the above mentioned problems, four of them did not take it for credit and were classified as auditing the course. Of the students participating, two were sophomores, and the remainder were juniors and seniors.

By request of the students, the emphasize of the program was placed on nursing careers. Other health occupations the students were familiarized with included: lab technician, x-ray technician, diet technician, physical therapist, and a dental technician. The great majority of the time was spent in the classroom, although field trips were made to Cozy Inn Nursing Home in East Rumford, Ledgeview Nursing Home in West Paris, and Rumford Community Hospital.

The instructor for the program was a registered nurse with several years of experience in both nursing homes and hospital settings. The instructional materials used consisted of: Being a Nurse Aide, published by Prentice Hall, filmstrips supplied by the division of Hospital Services (Dept. of Health and Welfare), and filmstrips and other material provided by Rumford Community Hospital.

The results of the project were positive in that students were able to gain insight and experience into the health occupations in general, and nursing specifically, through involvement on both an academic and experiencial level. Of the eleven students that participated, seven have taken action that reflects a definate commitment to pursuing a health related career. The remaining four are still uncertain as to their goals, but this experience has given them sufficient knowledge through which they may more effectively evaluate this particular career potential.

Those students who took the course for credit were evaluated through a comprehensive final exam covering basic patient care skills. On a scale of 100, the ranks on that exam ranged from 65 to 93.33 with an average of 83.55.

The program was a success in meeting the basic orientation needs of the s students participating. The greatest problem encountered was an organizational one, and centered around establishing a time for the course to meet that would result in the lest number of conflicts for the students. The program was held in the middle of the school year, at a time after all students had selected their other courses as well as having made commitments to a variety of activities. This unfortunately eliminated participation on the part of some students that had some interest resulting in a reduced enrollmtn in the program. It is recommended that in the future such a program be tied in earlier with a regular school curricular, thereby allowing more students to participate.

OUTLINE

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C. Filmstrips: 1. Ethics of Nursing Assistant
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XI. A. Patient Unit

1. Making occupied bed
2. Filmstrip: Occupied Bed Making

XII. A. Care of Dying Patient

1. Emotional and religious needs of patient and family
2. Care
3. Signs of death

B. Postmortem care

INSTRUCTOR'S REPORT

The Health Career Orientation Course which started on November 12, 1974 was completed on January 7, 1975. Final exams were given on January 8 and 9, 1975.

At the request of the participating students, emphasis was placed on a Nursing Adie course. Materials used included the textbook "Being a Nursing Aide" prepared by Hospital Research and Educational Trust; filmstrips supplied by the Division of Hospital Services (Department of Health and Welfare), and Rumford Community Hospital, as well as additional materials from Rumford Community Hospital.

Field trips were taken to Cozy Inn Nursing Home in East Rumford, Ledgeview Nursing Home in West Paris, and to Rumford Community Hospital. At the nursing homes, students were assigned to an experience aide and were allowed to observe and participate in a small degree in routine patient care. At Cozy Inn Nursing Home the Activities Director discussed his work, job qualifications, and educational requirements. An appointment made with the Physical Therapist and Therapist Aide had to be postponed due to inclement weather. The Dental Hygienist also had to cancel her appointment at this time.

At the Rumford Community Hospital, the Aides were introduced to a Laboratory Technician, an X-ray Technician and a Diet Technician. They demonstrated and discussed their work, qualifications, and educational requirements. The students were given a tour of the Hospital.

One student who showed a strong interest in Physical Therapy spent several days working as a volunteer with the Therapist at Rumford Community Hospital.

The Nursing Aide Course covered material in the textbook which would be applicable to an aide working in a nursing home. This was done due to the limited time allowed for the course, the lack of equipment and facilities at the school but also because of the more certain possibility of employment in a local nursing home. This course could not qualify a student to work at Rumford Community Hospital and they had been informed of this prior to taking

the course. Students were taught to take and record TPR's and B/P; also how to give back rubs. Except for their exposure at the nursing homes, no other practical nursing was possible.

A strong emphasis was placed on medical terminology and abreviations as well as Nursing Care goals. A bery basic and minimum amount of anatomy was covered.

After employment at a nursing home students will expect to undergo the usual orientation program for an untrained aide. They will be encouraged to check a performance task list which has been coordinated with the textbook and to continue to use the textbook as an excellent source for reference and refresher.

PREFORMANCE TASKS

1. Admit patient and orient to nursing home. Ch. 11, pgs. 1-6
2. Assist charge nurse with transfer and discharge of patient. Ch. 11, pgs. 7-12
3. Assist in dressing and undressing a patient. Ch. 7, pgs. 18 19
4. Assist in lifting, moving and transferring patient. Ch. 6, pgs. 1 22
5. Assist in feeding patient. Ch. 8, pgs. 13-26
6. Assist in bathing patient. Ch. 7, pgs. 6-16
7. Give Backrub. Ch. 7, pgs. 16 18
8. Give shampoo. Ch. 7, pgs. 20-24
9. Assist patient with personal hygiene. Ch. 12, pgs. 1-13
10. Give bedpan and urinal. Ch. 7, pgs. 26-29
11. Take TPR and B/P. Ch. 10, pgs. 8-26
12. Apply heat or col applications. Ch. 13, pgs. 1-23
13. Collect specimens. Ch. 9, pgs. 9-20
14. Distribute fluids to patient. Ch. 8, pgs. 22-23
15. Measure I. & O. Ch. 9, pgs. 1-9
16. Assist in postmortem care. Ch. 17, pgs. 6-9
17. Change bed linen. Ch. 5, pgs. 7-19
18. Serve patient trays. Ch. 8
19. Observe and report needed repairs and services (light bulbs, dripping faucets, etc.).
20. Maintain all service areas in good safe condition.

HEALTH OCCUPATIONS FINAL

1. How do you test to find sugar in a diabetec's urine?

2. What is considered as normal for an oral temperature?
   What is considered normal for a temp. taken rectally?
   What is the difference between an oral thermometer and a rectal thermometer?

3. What is I. & O.?
   Why would a pt. be on Force Fluids? What does Force Fluids mean?
   What is edema? What is de-hydration?

4. What are four basic diets?

5. What do you do while feeding a blind Pt.? What are your obligations if the blind patient is feeding himself?

6. What is:

NPO	SSE	FWB
BRP	SOE	P.T.
PRN	N/V	pt.
IGO	I.V.	EKG
ADL	DSD	↑
inc	Ca	
Ad Lib	H_2O_2	
qs	TLC	
DM	ROM	
amb.		

7. What about your personal appearance while on duty? Give some detail.

8. What is found in a typical patient's unit?

9. What is a trocanter roll?

10. What is Clinitest tablet used for?
    What is a sphygmomanometer used for?
    What is a stethoscope used for?
    What is a gurney used for?
    What is "staph"? (not staff)

11. List 5 common sense safety rules to apply to patients.

12. How can you prevent spread of infection from pt. to pt. or nurse to pt.?

13. What is temperature?
    pulse?
    respiration?
    blood pressure?

14. Arteries are vessels which carry blood _____ the heart.
    Veins are vessels which carry blood _____ the heart.

15. When would a rectal temp. be taken?

16. Which method of temp. taking requires lubricating jelly?
takes about ten minutes?
gives a normal reading of 98.6?
would you use a thermometer with a long tip?

17. List three things to remember when taking a pulse?

18. What is Chene-Stokes respirations?
What is the death rattle?

19. Define:
Liter
Litter
bedrest
dis-oriented
thrombophletis
arthritis
urine
emesis
impaction
contracture
empathy
purulent
dyspnea
umbilical region
epidermis
sternum
coccyx
decubitus ulcer
dentures
oral hygiene
edema
dehydration
sympathy
pain
cardiac

20. What would an aide look for with a pt. having an IV? List 4.

21. What is a catheter and why would it be used?

22. What is the best position for an SSE?
How much fluid would you use?
About what temperature?
How do you get the air out of the tube?
How long should pt. retain the solution?

23. Why would an IV be ordered?

24. What are Nursing Aide duties? List 10.

25. What are four basic positions for bed pt.?

26. List 5 things you'd report to a charge nurse.

27. List 5 reasons for bathing a patient?

28. List 5 causes of bed sores. How can bed sores be prevented?

29. What do you do for a patient who is eating at his bedside or in bed before serving his meal?

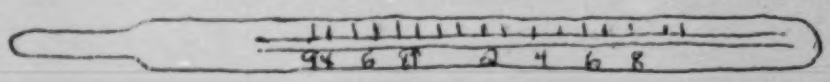
30. Define:
Contracture
Rectum
Apnea
Benign
Malignant
Hypertension
Hemorrage
Atrophy
Arthritis

31. What are you obligations to a dying patient, his family?
What are your obligations to a patient who has expired? (died)

32. What is nursing all about? List at least 5 Nursing care goals.

33. Show 99°

Show 101



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ACCESSION NUMBER: VT102547

PUBLICATION DATE: 24JUL75

TITLE: JOB CAREER GUIDANCE. URBAN LEAGUE OF GREATER HARTFORD END OF THE YEAR REPORT 1975.

DESCRIPTOR: *OCCUPATIONAL GUIDANCE; *URBAN DROPOUTS; *DISADVANTAGED YOUTH; JOB PLACEMENT; *PROGRAM DESCRIPTIONS; STUDENT REHABILITATION; *OUT OF SCHOOL YOUTH; HIGH SCHOOL EQUIVALENCY PROGRAMS

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 9P.

ABSTRACT: THIS PROJECT WAS SET UP TO PROVIDE OCCUPATIONAL INFORMATION, COUNSELING, JOB PLACEMENT, AND THE OPPORTUNITY TO OBTAIN A HIGH SCHOOL EQUIVALENCY DIPLOMA TO UNEMPLOYED OUT-OF-SCHOOL YOUTH FROM DISADVANTAGED FAMILIES IN THE GREATER HARTFORD AREA. ONE HUNDRED AND THIRTY-TWO DROPOUTS WERE CONTACTED AND COUNSELED, AND 104 WERE TESTED AND PLACED INTO A JOB TRAINING PROGRAM. FORTY-SEVEN STUDENTS WERE PERSUADED TO ENROLL IN A PROGRAM TO PREPARE THEM FOR THE HIGH SCHOOL EQUIVALENCY DIPLOMA IN THREE MONTHS. ON-THE-JOB PLACEMENT COUPLED WITH INTENSIVE INDIVIDUAL AND GROUP COUNSELING WAS PROVIDED TO THE PARTICIPANTS OF THIS PROGRAM DURING 1974-75. (NJ)

INSTITUTION NAME: URBAN LEAGUE OF GREATER HARTFORD, CONN.

SPONSORING AGENCY NAME: OFFICE OF EDUCATION (DHEW), WASHINGTON, D.C.

102 547

JOB CAREER GUIDANCE
URBAN LEAGUE OF GREATER HARTFORD
END OF THE YEAR REPORT 1975

Urban League of Greater Hartford
1229 Albany Avenue
Hartford, Connecticut

Job Career Guidance
William C. McGarrah
Director July 24, 1975

VT 102 547

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PREFACE

This program has been developed in recognition of a statewide need which reflects changing employment and population patterns. Educators have been concerned about the growing importance of guidance and the general inaccessibility in succinct form of much of the important thinking on the education and counseling of minority group youth.

At the local level it is readily acknowledged that desirable education has as its chief aim the maximum development of each individual. Within the past two decades, the scope of education has been extended outward from the strictly academic to include a concern for the total development of each individual student. Numerous professional and lay groups have pointed out the need for services supplement to those provided by the classroom teacher through the instruction of the basic skills. American educators have long realized the restrictive effects of pupil indecision, lack of adequate goals, emotional maladjustments, and of generally unrealistic understanding of themselves, of their potential and of their future. In spite of a major goal of desirable education, recognition of the need for elimination of restrictions, and efforts for maximum student development, we are not without our out-of-school unemployed youth, its restriction for maximum development within some groups, and its problems in motivating and educating all students. It is generally acknowledged that many out-of school unemployed youth are the products of social deprivation with its concomitant effects upon individual motivation to excel as well as possible, and upon individual hope for the future. Many of our youth whose environment is one of social deprivation are also youth representing various minority groups.

PREFACE (cont'd)

The labor picture continues to be critical because of the everwideing gap between the education and the training of minorities, on the one hand, the requirements of the labor market on the other. The dramatic changes in employment patterns and the kinds of occupations have challenging implications for education. Passing the general education level of American youth has become on of the most critical problems of this country; and although attention has shifted to the dropout, the education to the nation's youth requires not just getting them through high school, but preparing them, for either subsequent employment or to continue their education beyond high school. It is not merely the lack of diploma, however, which heeps employers from hiring dropouts, states one of the best reports on this problem. It is their lack of preparation for any sort of job.

SETTING

There are overwhelming facts concerning our manpower needs which make the development of all our human resources a necessity. Economically we cannot support our standard of living for an exploding population and maintain an adequate defense, without making use of all our human resourses. There is a big shift taking place in the United States economy, more people are becoming doers, and not makers. The local business and industry, there are many job opportunities. Furthermore, many lack the knowledge of their own aptitudes and abilities and therefore do not apply for there postions. Career Guidance intends to help decrease youth unemployment for disadvantaged groups. The Urban League has developed and dispensed career guidance information relative to existing job openings in the Greater Hartford Area. We have recruited many of the high school dropouts in the inner-city and target areas. Last year we were able to abtain a list of over 260 high school dropouts from the Board of Education. On-the-job placement coupled with intensive individual and group counseling has been provided to hese high school dropouts.

METHODS

Career Guidance was able to establish a working agreement with Eileen Browne of the Comprehensive Manpower Program (CMP) to administer aptitude testing for our clients. Ms. Mary Womach, Director of Project Matthew agreed to admit our clients into her program in order for them to gain their graduate equivalency diploma. A similar agreeemtn was made with Mr. Delando Watson, Director of the Neighborhood Youth Core (NYC). They agreed to accept our dropouts between the ages of 16 and 13 years old, who come from economically disadvantaged families. These clients would receive job training while enrolled in NYC.

The Career Guidance Program began working with a list of over 260 high school dropouts. We were able to contact and counsel 132 dropouts from this list, 104 were tested by the Comprehensive Manpower Program and placed into its job training program. Seventy-Eight of the people counseled were young men which is about fifty-nine (59%) and 54 were young women, which is about forty-one percent (41%).

Hartford High led the way with 109 dropouts, closely followed by Weaver High with 90 and Bulkeley High with 61 dropouts. Along with the list of dropouts, a reason was given why these students didn't return to school. The school board listed many students with non-attendance as being dropouts. Career Guidance raised the question did anyone from the school system try to encourage these students to stay in school and to what extent did they try to encouraged them to stay in school. We found that many students, about 117 or 45% of the total 260 were encouraged to dropout. What we at Career Guidance did with these

METHODS (cont'd)

117 students, was to try to give them and understanding of what a high school education is worth and what the value of on-the-job training would be worth. We were able to persuade 47 students to enroll in our Project Matthew. Project Matthew or Street Academy which it is often called, is an Urban League Program which prepares its students for their high school equivalency in three months.

The Career Guidance Program has set-up an advisory committee which meets periodically. The advisory committee's purpose is to help strengthen our program by making constructive observations as to how the program is operating. Career Guidance worked closely with the staff of Project Matthew in providing counseling to their students.

SUMMARY

With the development of the past and with the present activities, what then is the outlook for career guidance? We believe that the outlook is encouraging but the future status of guidance for all youth will depend upon the continual exploration of issues, the continued and increased support for guidance, and the outcomes of youth which can in part at least be identified with the work of the school counselor. However, there are several important problems that need to be met.

There is a need for the better understanding and knowledge of the role of guidance in assisting all children and youth. We must fulfill the need for more organized in-service education to supplement the pre-service education of counselors presently working in the schools. Presently there is a shortage of counselors which must be filled. More money must be available to support a comprehensive program of guidance services. Finally we must have an improved working relationship between counselors, other pupil personnel workers, teachers, community groups and the students enrolled in our schools.

RECOMMENDATIONS

Each school year, the state vocational high schools admit approximately 200 students into its freshmen class. Career Guidance would like to start preparing seveth and eighth grade students for admission into a vocational high school.

Many people have voiced concern about the counseling program in the secondary schools. Frequently mentioned concerns were the need for expanded behavioral counseling, increased assistance to students with a problem, increased attention to truancy, improved information about vocational careers and opportunities.

ACCESSION NUMBER: VT102548

PUBLICATION DATE: 15JUL75

TITLE: ALTERNATIVE PROGRAM. EXEMPLARY PROGRAM. FINAL REPORT.

PERSONAL AUTHOR: SPAGNOLA, EUGENE F.

DESCRIPTOR: *POTENTIAL DROPOUTS; DISADVANTAGED YOUTH; *ALTERNATIVE SCHOOLS; *STUDENT REHABILITATION; DEVELOPMENTAL PROGRAMS; *JUNIOR HIGH SCHOOLS; PROGRAM DESCRIPTIONS; COMPENSATORY EDUCATION PROGRAMS; *CAREER EDUCATION

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 14P.

ABSTRACT: DURING THE 1974-75 SCHOOL YEAR, THE ALTERNATIVE SCHOOL PROGRAM PROVIDED SELECTED POTENTIAL DROPOUTS AT THE JUNIOR HIGH LEVEL IN WATERBURY, CONNECTICUT, WITH AN EDUCATIONAL PROGRAM DESIGNED TO OFFER THE OPPORTUNITY TO DEVELOP SOCIAL AND SELF-CONCEPTS, PROPER WORK ATTITUDES, ADEQUATE READING AND MATH SKILLS, AND A DESIRE TO ACHIEVE. THE GOALS OF THE PROGRAM WERE TO PROVIDE RELEVANT CURRICULUM COORDINATED WITH VOCATIONAL EXPLORATION, INDIVIDUALIZED PROGRAMS IN READING AND MATHEMATICS TO REDUCE COMPETITIVE PRESSURES, AND GUIDANCE AND INSTRUCTION IN THE DEVELOPMENT OF SELF-AWARENESS, WORTH, AND DIRECTION. THE SCHOOL POPULATION CONSISTED OF DISADVANTAGED STUDENTS FROM 14-19 YEARS OF AGE AND WERE SELECTED ACCORDING TO THE FOLLOWING FACTORS: OVERAGED FOR GRADE; POTENTIAL DROPOUT; NONSCHOOL ORIENTED; AND LOW VOCATIONAL AWARENESS, ASPIRATION, AND ACHIEVEMENT. THE PROGRAM ACTIVITIES CENTERED AROUND THE INDIVIDUAL NEEDS OF THE STUDENTS; WITH AN EMPHASIS ON THE INTERACTION OF ACADEMICS AND VOCATIONAL AREAS. STUDENT MOTIVATION WAS INCREASED AS DEMONSTRATED BY AN APPRECIABLE IMPROVEMENT IN ATTENDANCE AND IN THE EXPRESSION OF STUDENT ATTITUDES. (NJ)

INSTITUTION NAME: WATERBURY BOARD OF EDUCATION, CONN.

SPONSORING AGENCY NAME: OFFICE OF EDUCATION (DHEW), WASHINGTON, D.C.

102 54

WATERBURY DEPARTMENT OF EDUCATION
VOCATIONAL EDUCATION
WATERBURY, CONNECTICUT

DR. MICHAEL F. WALLACE - SUPERINTENDENT OF SCHOOLS

ALTERNATIVE PROGRAM
EXEMPLARY PROGRAM FINAL REPORT

Mr. Eugene F. Spagnola - Vocational Education
Croft Building- 757-1191 Ext. 291

July 15, 1975

VT 102 548

2

WATERBURY DEPARTMENT OF EDUCATION
VOCATIONAL EDUCATION
WATERBURY, CONNECTICUT

TITLE:	Alternative Program
CONTRACTING AGENCY:	Waterbury Board of Education Dr. Michael F. Wallace Superintendent of Schools
DURATION OF PROGRAM:	One (1) Year - 1974-75
PROGRAM EVALUATORS:	Dr. Michael F. Wallace Superintendent of Schools
	Mr. John Ciavarella Director of Secondary Education
	Mr. Eugene F. Spagnola Supervisor of Vocational Education
	Mr. Joseph Cavanaugh Principal - Alternative Program
PROGRAM LOCATION:	Croft School Waterbury, Connecticut
TOTAL FEDERAL FUNDS:	$30,093
DATE TRANSMITTED:	July 15, 1975

WATERBURY DEPARTMENT OF EDUCATION
ALTERNATIVE PROGRAM
WATERBURY, CONNECTICUT

PROGRAM PERSONNEL

Principal	Joseph Cavanaugh
State Department of Education	Francis A. Ferrucci
	Charles Bertagna
Alternative Program Staff	1. Anthony Agostine Business Education
	2. Nicholas Evancha Mathematics
	3. Joseph Avellani Communications
	4. John Taglia Communications
	5. Lawrence Deschaine Automotive
	6. Edward Kennedy Wood Shop
	7. Ida Turner Career Education Specialist
	8. Leroy Scott Science - Mathematics
	9. Thomas Napiello Metal Shop
	10. Robert Marcella Business Education
	11. David Rossi Communications

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Overview

The following report is a comprehensive analysis of the development, initiation and evaluation of the exemplary, Alternative School Program.

The Alternative School dealt with students primarily on the 7th, 8th, and 9th grade level. The program was designed to serve the students of all the schools within the Waterbury School System.

The target population was selected by the following factors:

A. Overaged for present grade situation

B. Potential Drop-Out

C. Non-School Oriented

D. Low vocational awareness, aspiration, and achievement

The intention of the program was to enhance the students self-image, and develop their skills and applications of mathematics and language arts. A major effort of the program was to change the students attitudes toward themselves, others, and the educational system and processes.

Statement of Problem

In Waterbury, as is typical of school systems throughout the country, young people complain that their education is not opening pathways to a fulfilling adulthood. Substantial numbers of students signal their discontent through involvement with drugs, vandalism, and other behavioral problems. Our greatest concerns center around those students who have been "turned off" by the system and have programmed themselves as dropouts and delinquents.

The Alternative School provided school administrators and community agencies with an alternate solution and retrieval for serving non-school oriented youths

through relevant and innovative approaches which integrated career exploration into a total relevant educational environment. The program provides students with the opportunity to realize that school can be fun, develop social and self-concepts, proper work attitudes, adequate reading and a desire to achieve.

Objectives

The program objectives were:

A. To develop an alternate educational program for students whose behavioral attitude in school would indicate a high dropout potential and delinquency risks.

B. To provide an alternate method for meeting the needs of students who are not succeeding in the standard school environment.

C. To provide participants with a relevant curriculum to meet their individual desires, and life goals.

D. To have the student develop a respect for the dignity of work and to provide students with a realistic view of the world of work.

E. To enhance the students career aspirations.

F. To provide the student with the basic skills necessary to become an active and productive citizen within the community.

G. To develop positive student attitudes toward the local law enforcement agency.

H. To prepare students for an adjustment to the high school environment or to the world of work.

Program Goals

The goals of the Alternative School were aligned to the needs of and desires of the target population served:

A. To provide a meaningful curriculum.

B. To provide students with guidance and instruction necessary to develop self-awareness, worth, and direction.

C. To relieve unfavorable student competitive pressures.

D. To introduce a vocational exploratory curriculum.

E. To develop the individualized programs for reading and mathematics.

F. To reduce the potentially high drop-out rate of the target population.

G. To be turned on to life.

Program Goals - Expansion

The following is an expanded statement to clarify the reason behind the program goals:

A. The academic and vocational studies revolved around a positive attitude and have application to existence and success in our present day society. Present day events and problems are capitalized on their relevancy and their application where possible. Those teachings are then related to future expectations.

B. Because each child is part of his own family, he should know himself in relation to this group. Yet he also exists apart from his family with unique quality and values of his own. The classroom should be a supportive setting in which he can explore this duality and accept it comfortably. This would enable the child to respect the individual qualities of others and set

meaningful life goals in balance to his capabilities.

C. The mastering of academic skills in the abstract without pratical application limits the students ability to find the students relevancy. A method which stressed abstract reasoning is frustrating and detrimental to those students whose strengths are other than in the abstract domain.

D. By coordinating an academic curriculum with a vocational exploratory program, student needs and desires can be met so as to provide both concrete "hands on" experience in the "real world of work" and the sometimes vague, abstract academic studies.

E. With body knowledge of the learning and teaching process it is unrealistic to set class standards and not teach to the student's individual needs. The individual program allows the student to complete comfortably against his own rate of progress.

F. By relieving the pressures of an academic environment which many of these students rebell against and by providing them with a course of study and a programized approach for success, the stigma of failure should be greatly diminished so as to make school a more enjoyable experience.

G. Career Education will be an integral part of the Alternative School. The main components of Career Education will be emphasized by a Certified Career Education Specialist.

The Objectives are:

1. To help each student develop an awareness of the World of Work.
2. To provide experience which will enhance the self concept

of each student, focusing on his strengths and weaknesses, his aptitudes and capabilities and his interests and needs.

3. To help the student practice and develop logical direction setting and decision making skills.

4. To offer the student realistic exploratory experiences, to test himself against the activities and requirements typical of a number of career areas.

Problem Area and Individuals Served

The program serves 7th, 8th, and 9th grade students from all the elementary schools in Waterbury, Connecticut. The school population consisted of both male and female students ranging from 14-19 years of age. The clientele was represented by White, Black, and Puerto Rican youths.

The students were selected for the Alternative School by the original school teachers and principals and Special Services. The main criteria for the selection of the individuals served was their non-achievement in the regular school situation.

Essentially the problem difinition is the failure in language arts, low aspirations, mis-guidance, and poor-self- image; all of which are causitive factors of a high incidence of drop-outs and poor attendance.

Exemplary Features

The program is classified as exemplary in that it follows the dictum..... The primary function of an exemplary program is to broaden the aspirations..... with special emphasis.....to youth with socio-economic and academic handicaps.

Under the definition of the federal guidelines of economics, social and academic, 100% of the Alternative School's Population can be classified as

disadvantaged.

The primary function can be seen throughout the program's description in terms of both the population served and the content of the program offered.

Future Budget

It is the policy of the Waterbury Board of Education to fund programs that are deemed successful and vital to the welfare of the students served.

The Alternative School Program, which has been housed at the Chase Park House and Kennedy High School, has its own house at Croft School using all the Vocational Education facilities made available by the closing of Crosby High School. The school hours are from 8 A.M. to 2:10 P.M. daily. Students are dismissed at 12:00 P.M. daily, teachers remain until 2:10 daily. School credits are awarded to each student who makes the transition to a regular school situation.

The Alternative School Program was directed toward the potentially non-college bound student. The students taken were those who were over-aged for their grade situation, and classified as non-school oriented because of a negative attitude toward school and education.

A portion of the student population, who have had past behavioral problems in school, home, and in the community are under the care of professional personnel for their social maladustments. A majority of the students suffer from a rather limited frame of references and have had experiences dealing mainly with inner-city living.

Another group of students are hampered by a limited potentiality of academic growth. This limited potential, compounded by their frustrations from competing with students of high levels, and the arbitrary failure mark of the standard

grading system which they have received has caused a most negative reaction toward school, teachers, and the educational process, as well as their future worth.

Setting To Which Objectives Apply

To help overcome the problems of the target population, a relatively low pupil-teacher ratio is provided. This is coupled with the new setting for the youths involved. The selected students were transfered from their original schools to create a new and separate student body. The natural corrolary to such a setting was an innovative curriculum for a 7th, 8th, and 9th grade learning situation.

Ratios:

Teachers	Pupil	Ratio
10	150	1/15

Professional Pupil Ratio

Professional	Pupil	Ratio
10	150	1/15

Non Profit-Private School Participation

The Alternative School program was made available to non-profit private schools who has problems that fit the same general criteria as the students being selected.

Budget

The Alternative School program was granted funds under the Vocational Act Section D. The total amount of funds granted was $30,093.00. The funds were granted for a time period equal to one school year of development and operation. The total cost of the program for the 1974-75 school year can be broken down into the following categories, and the respective amount spent in each:

I. Direct Costs:

Personnel -	
1 Principal	$13,500
1 Business Teacher	11,144
1 Secretary	5,200
Supplies & Materials	249
	$30,093

Non Commingling of Funds

It is the policy of the Waterbury Board of Education not to commingle Federal Funds with State and Local Funds. The same policy was maintained with the receipt of funds for this program.

Description of Student Population

1. Language Barrier
2. Cultural Differences
3. Limited Potential
4. Disadvantaged Environment
5. Poor Socialization Abilities
6. Negative View of the World of Work
7. Juvenile Court Records

A segment of the student population experienced language barriers where a second language is spoken in the home. These students have no one to turn to at home when help with school work is needed.

Cultural goals and expectations of the parents do not correspond with the expectations of the regular school, causing confusion in the student. Many times a student's peer group does not reward academic success. In many cases, rebellion and toughness is favorably accepted by peer groups both within the school environment and in the neighborhood.

Recommendations

The following is a list of recommendations which would greatly improve the operation and effectiveness of the Alternative School.

1. Alternative School being housed in its own facilities.
2. Elimination of busing.
3. Open school concept.
4. An additional Vocational Shop to teach Small Combustible Engines.
5. Expansion to 10th grade. (Total 200 students)
6. Addition of a course of study in the area of Science for the 9th grade.
7. Expansion of staff (from 10 to 14) to compensate for added students and courses.

Program Activities

The program activities again centered around the individual needs of the students. An interaction between the academics and vocational areas was stresses. By means of a "hands-on" approach in the various shop sections the curriculum became more meaningful and students developed a need to gain more skill in the academic areas.

Reporting the Evaluation

The Alternative School Program at the closing of its 3rd period of implementation, has reached its pre-established goals and objectives.

The program is meeting students' needs more effectively. The students are enjoying school more, and are progressing toward more positive goals and achievements.

Many more responsibilities have been placed upon the students for wise decisionmaking and behavioral performance. The students of the Alternative School

have accepted this responsibility and have performed well under unique conditions.

Because of the change in attitude toward school, and the more relevant curriculum, many students who would otherwise have done poorly, or may have dropped out, or have been discipline problems, have had a second chance and have profited by it. They now have a chance to continue their education.

Evaluation by the individual teacher in respect to this course is included, along with an evaluation report of the Parent Advisory Committee, and the students themselves. The Board of Education has adopted this program (grades 7-10) as part of the next years school budget.

Student Motivation

The student response to the Alternative School has been extremely good. Students have expressed their feelings of liking school more, and feel as though they are doing better. The attendance of students who cut school extensively has appreciatively improved. The attitude towards their abilities has increased continuously. Students select not to attend shop so as to complete math assignments and reading for class activities. The response in all areas has been very encouraging.

Many parents have written, expressing a noticeable change in their child's attitude, attendance, and performance since attending the Alternative School.

ACCESSION NUMBER: VT102554

PUBLICATION DATE: 30JUN75

TITLE: KIMBALL OCCUPATIONAL EDUCATION PROJECT. QUARTERLY REPORT.

DESCRIPTOR: *CAREER EDUCATION; *DEVELOPMENTAL PROGRAMS; *RURAL SCHOOLS; FIELD TRIPS; REPORTS; ELEMENTARY SECONDARY EDUCATION

EDRS PRICE: MF AND HC AVAILABILITY WILL BE ANNOUNCED IN VOL. 9, NO. 4.

DESCRIPTIVE NOTE: 31P.

ABSTRACT: THE MAJOR ACTIVITIES AND ACCOMPLISHMENTS OF THE CAREER EDUCATION EXEMPLARY PROGRAM AT KIMBALL SCHOOL DISTRICTS 1 AND 3, NEBRASKA, FOR THE QUARTER ENDING JUNE 30, 1975 ARE BRIEFLY DESCRIBED. TEACHER'S EVALUATIONS OF FIELD TRIPS, A SUMMARY OF MONTHLY REPORTS, AND COPIES OF STAFF PUBLICATIONS AND PUBLICITY ARE APPENDED.

INSTITUTION NAME: KIMBALL SCHOOL DISTRICTS 1 AND 3, NEBR.

SPONSORING AGENCY NAME: OFFICE OF EDUCATION (DHEW), WASHINGTON, D.C.

102 554

QUARTERLY REPORT

Kimball Occupational Education Project

Conducted Under

Part D of Public Law 90-576

Kimball School Districts 1 and 3

901 South Nadine Street

Kimball, Nebraska 69145

June 30, 1975

VT 102 554

2

EXEMPLARY PROGRAMS AND PROJECTS

Quarterly Report # 3

Period Covered by this Report April 1, 1975 to June 30, 1975

CONTRACT GRANTEE Kimball Public Schools Districts #1 and #3

Title of Project The Implementation of a Comprehensive K-Adult Career Education Program in a Rural Setting.

Name of Project Director Joan DeLong

I. Staff Utilization:

II. Capital Equipment Acquisitions:

III. Major Activities and Accomplishments:

IV. Activities and Events Planned:

V. Problems Encountered:

VI. Dissemination Activities:

Charles O. Morehouse
Project Initiator (Signature)

Joan J. DeLong
Project Director (Signature)

School Official Max F. Hensley
Signature

Date Submitted: July 25, 1975

EXEMPLARY PROGRAMS AND PROJECTS

QUARTERLY REPORT

FROM APRIL 1, 1975 to JUNE 30, 1975

I. STAFF UTILIZATION

Staff remained the same as previously reported.

II. CAPITAL EQUIPMENT ACQUISITIONS

None

III. MAJOR ACTIVITIES AND ACCOMPLISHMENTS

A. Distribution and explanation to staff of the comparison study of the pre and post-test results.

Meetings were held with the teachers of each building to distribute and explain the comparison study of the pre and post test results and to hand out other materials which had been collected.

B. Field Trip Evaulation Forms

During the meeting described in the paragraph above, Field Trip Evaulation Forms and previously completed Monthly Report forms were given to the teachers. The teachers evaluated each field trip he or she had taken and the results were compiled to be used during the In-Service workshop to be held in August, 1975. A copy of the evaluation results is found in Appendix A.

C. IN-SERVICE WORKSHOP - AUGUST 1975 PLANNING

Beginning August 21 the teachers in the Kimball Schools will be attending a series of workshops, some of which will be concerned with Career Education. Dr. Paul Welter, a professor from Kearney State College will be working with the elementary, junior high and senior high teachers separately for half days on becoming more person or student-centered. Other times during the two days of workshops will be devoted to some workshops with the project director using the revised units and flow charts which have been developed during the summer.

D. High School Counselor's Activities

In the adult portion of the high school career education program seventeen recent dropouts were given the G.E.D. Twelve of these individuals completed the test and five did not. Three individuals who dropped out of school five or more years ago completed the G.E.D.

Fifteen students participated in the work study program which is available. Credit is given for the work study activities to help fulfill granduation requirements. In May the counselor presented the work study program to the Kimball County High School Board of Education. The counselor met with the Kimball-Banner County Chamber of Commerce to bring them up to date on the operation of the program and to stress the need for their continued cooperation.

Group guidance sessions were held for all freshmen and sophomore students for the purpose of interpreting the General Apptitude Test Battery scores and the relationship of these results to the Dictionary of Occupational Titles.

Twenty-one students were place in summer jobs, full time jobs or vocational school programs. Eight students obtained part time summer work, five were placed in full time positions, and ten enrolled in vocational school programs.

E. Junior High Counselor's Activities

June 13, the Junior High counselor served as a resource person for two summer school classes at Chadron State College, Occupational Information and Guidance Principles and Practices. The Kimball Occupational Education Project was shared with both groups as well at the guidance and counseling role in career education through discussion, slide presentation and display of materials.

F. Career Corner Publication

The Career Corner was again a monthly publication to all staff. Copies of the April and May Issues are included in Appendix B.

G. On Going Classroom Activities, Field Trips, Etc.

Appendix C includes the summary of the Monthly Reports from April and May concerning classroom activities and field trips.

IV. ACTIVITIES AND EVENTS PLANNED

A. Development of tape cassettes to accompany slide presentations concerning the bakery, the creamery and other careers in the Kimball community.

B. In-Service workshop for all staff August 21-22, 1975.

C. In-Service workshop to be held in September, 1975 involving William Page from Educational Consutling Services of Nashville, Tennessee.

V. PROBLEMS ENCOUNTERED

None

VI. DISSEMINATION ACTIVITIES

A. The activities related to career education at the junior high school are reported in the Shorthorn Corral, a section in the Western Nebraska Observer. The copies of these articles can be found in Appendix D of this report.

B. The Kimball-Banner Chamber of Commerce was visited by Charles Morehouse, the high school counselor to discuss the work study program discussed earlier in this report.

APPENDIX A

FIELD TRIP EVALUATION RESULTS

FIELD TRIP EVALUATIONS

1974/75

1. Was the trip effective in terms of meeting instructional objectives ?
2. Did the trip provide motivation for new interests ?
3. Were students questions answered during the trip ?
4. Were the students able to understand the speaker ?
5. Was the trip suitable for the age of students who took the trip ?
6. Would you take your class on this field trip again next year ?
7. Does the trip provide an addition to the community resource file ?
8. Do you feel that there is improvement to be made so that the student will learn something from the field trip ?
9. Was the trip beneficial to the student ?

FIRST GRADE	#1	#2	#3	#4	#5	#6	#7	#8	#9
High School Science Dept. (M.L)	Y	Y	Y	Y	Y	Y	N	N	Y
Motel Kimball	Y	Y	Y	Y	Y	Y	Y	N	Y
Cawleys Potato Chip Factory (W)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Dairy Farm	Y	Y	Y	Y	Y	Y	Y	Y	Y
Riverside Zoo	Y	Y	Y	Y	Y	Y	Y	Y	Y
Kimball County Hospital	Y	Y	Y	Y	Y	Y	Y	Y	Y
HR Qualls Inc.	Y	Y	Y	Y	Y	Y	Y	Y	Y
D & J Conoco	Y	Y	Y	Y	Y	Y	Y	Y	Y
House Under Construction	Y	Y	Y	Y	Y	Y	Y	Y	Y
J.K. Chevrolet (We would like to visit Larry Larson Ford next year)	Y	Y	N	N	Y	N	Y	Y	N
Dentist	Y	Y	Y	Y	Y	Y	Y	Y	Y
Telephone Office	Y	Y	Y	Y	Y	Y	Y	Y	Y
First State Bank	Y	Y	Y	Y	Y	Y	Y	Y	Y

		#1	#2	#3	#4	#5	#6	#7	#8	#9
SECOND GRADE										
Safeway (Mr. Davis did a very good job guiding us through Safeway but he has been transferred. The guide is the important person in this field trip)	(M.L)	Y	N	Y	Y	Y	Y	Y	Y	Y
	(W)	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	N Y	Y Y
Post Office (Too difficult for second graders to comprehend. Wasn't enough stuff to see)	(M.L)	N	N	N	N	N	N	N	N	N
Radio Station (We also had a resource person come in and he was very effective in giving his talk and answering questions)	(M.L)	Y	Y	Y	Y	Y	Y	Y	Y	Y
	(W)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Kimball Creamery (Due to all the noise, it was very difficult to hear the speaker. However, the students did get to see the equipment)	(M.L.)	Y	Y	Y	Y	Y	Y	Y	Y	Y
	(W)	Y	Y	Y	Y	Y	Y	Y	N	Y
McDonalds (We heartily encourage every grade level to tour McDonalds. It was a great experience)	(M.L.)	Y	Y	Y	Y	Y	Y	Y	N	Y
Accessory Sales (Tom Wilson also came as a resource person before the trip)	(W)	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	Y N	Y Y
Fire Station (The person who was expected to be there to meet us to show us around was not there and we had to wait 15 minutes or more for someone to come)	(W)	Y	Y	Y	Y	Y	Y	Y	Y	Y

THIRD GRADE		#1	#2	#3	#4	#5	#6	#7	#8	#9
Kimball County Grain Elevator (ML) (Check for dust alergies)		Y	Y	Y	Y	Y	Y	Y	Y	Y
Accessory Sales (Other grades take it)	(M.L)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Redman Shoe Store	(M.L.)	Y	Y	Y	Y	Y	Y	Y	Y	Y
	(W)	Y	N	Y	Y	Y	Y	Y	Y	Y
Joes Shoe Repair	(M.L)	Y	Y	Y	Y	Y	Y	Y	Y	Y
	(W)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sew n Sew (Excellent for higher grade levels in more depth) (Too large of groups)	(ML)	Y	Y	Y	N	Y	N	Y	Y	Y
	(W)	Y	Y	Y	Y	Y	N	N	Y	Y
Cawleys Potato Chip Factory (Some children already had seen this)	(M.L)	Y	Y	Y	Y	Y	N		N	Y
	(W)	Y	Y	Y	Y	Y	Y	N	N	Y
Kimball County Historical Museum	(W)	Y	Y	Y	Y	Y	Y	Y	N	Y
Kimball Locker Plant	(W)	Y	Y	Y	Y	Y	Y	Y	N	Y

FOURTH GRADE		#1	#2	#3	#4	#5	#6	#7	#8	#9
Mary Lynch Electrical Circuits (met science objectives for study of electrical circuits and fuses)		Y	Y	Y	Y	Y	Y	Y	Y	Y
Fort Laramie (very interesting)	(M.L)	Y	Y	Y	Y	Y	Y	N	Y	Y
	(W)	Y	Y	Y	Y	Y	Y	N	N	Y
Police Station and County Sheriff Office	(M.L)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Kimball International Airport (resource material was available through Mr. McGee and Perc Center. These materials were utilized by most of the students)	(M.L)	Y	Y	Y	Y	Y	Y	Y	Y	Y

FIFTH GRADE		#1	#2	#3	#4	#5	#6	#7	#8	#9
Fire Station	(W)	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	N Y	Y Y
Cheyenne Telephone Office, Museum, Capital	(W)	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	N Y	N	Y Y
	(M.L)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Farm and Blacksmith Shop (Mr. and Mrs. Mayer have a wealth of knowledge about early Nebraska and the next trip might also capitalize on their knowledge of farming and rural life in earlier times.	(M.L)	Y	Y	Y	Y	Y	Y	Y	Y	Y

ALL ELEMENTARY GRADES										
High School Concert (Provided children with the experience of hearing a live performance)	(W & M.L)	Y		Y	Y	Y&N	Y	N	Y	Y

	#1	#2	#3	#4	#5	#6	#7	#8	#9
SPECIAL EDUCATION									
Kimball Library (We were not able to spend as much time as we wanted too)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ender's Oil Field (Needs to be showed down a bit for my particular group)	Y	Y	Y	Y	Y	N	Y	Y	Y
Scottsbluff Weather Bureau (Groups were too large. If more guides, then the kids won't be so restless and more attentive)	N	N	Y	N	N	Y	Y	Y	N
Missile Control Center (profitable but could have been explained more on the child's level than the adults. When I went through I felt it was aimed more at me than the kids)	Y	Y	Y	N	Y&N	N	Y	Y	Y
SIXTH, SEVENTH, EIGHTH GRADES									
Missile Control Center (smaller groups to enable more time for questions and discussion) (more time spent with fewer students to eliminate rushed feeling)	Y Y	Y Y	Y Y	Y Y	Y Y	Y N	Y Y	Y Y	Y Y
SIXTH GRADE									
Missile Site (interesting trip. Very suitable trip for students) (the tour of underground took longer than upstairs. This made one group have to wait) (more time to be spent in control center so that the pressure of gettinb back is not so great)	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	N Y	Y Y
Scottsbluff Weather Bureau (Disorganization at the bureau was the main problem. There were to be three guides, ended up only two)	Y Y	Y Y	Y Y	N	Y Y	Y Y		Y Y	Y Y

	#1	#2	#3	#4	#5	#6	#7	#8	#9
SIXTH GRADE (continued)									
Stanco Oil Field (Oil business is very interesting and important to community and economy. Very appropriate trip)	Y	Y	Y	Y	Y	Y	Y	N	Y
SEVENTH GRADE									
Missile Site (more time could have been taken to give the students a more extensive trip)	Y	Y	Y	Y	Y	Y	Y	Y	Y
(the trip above was too long and the groups too large. Downstairs it worked well, because the groups were broken up a little more)	Y	Y	Y	Y&N	Y	Y	Y	Y	Y
(Educational and beneficial but it was rushed at times and the kids didn't always understand)	Y	N	Y	Y&N	Y	Y	Y	N	Y
(should be more on a one to one basis. Too many participants in short time)	N	Y	Y	Y&N	N	N	N	Y	Y&N
	Y	Y	Y	Y&N	Y	Y	Y	Y	Y
Cooperative Grain	Y	Y	Y	Y&N	Y	Y	Y	Y	Y
EIGHTH GRADE									
Missile Site (not enough time)	Y	N	Y	Y	Y	Y	N	Y	Y
(good experience)	Y	Y	Y	Y	Y	Y	Y	Y	Y
(I think this trip if it does nothing more it helped to create public relations)									
(could be some lead in instruction given. Now we know what the trip is about. Follow up technique with more than discussion)									
Western Nebraska Tech. College	Y	Y	Y	Y	Y	Y	Y	Y	Y

	#1	#2	#3	#4	#5	#6	#7	#8	#9
NINTH - TWELFTH GRADES									
Denver Stock Show	Y	Y	Y	Y	Y	Y	Y	Y	Y
John Deere Field Day	Y	Y	Y	Y	Y	Y	Y	Y	Y
Scottsbluff Vo-Ag Contests	Y	Y	Y	Y	Y	Y	Y	Y	Y
State Convention	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sidney Vo-Tech	Y	Y	Y	Y	Y	Y	Y	Y	Y
Denver	Y	Y	Y		Y	Y	Y	Y	Y
Gotte Park	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cheyenne Hospital	Y	Y	Y	Y	Y	Y	Y	N	Y
Ag. Shop, Kimball Body Works	Y	Y	Y	Y	Y	Y	Y	N	Y
Omaha & Scottsbluff - MENC	Y	Y	Y	Y	Y	Y		N	Y
Western Nebraska Trip	Y	N		Y	Y	Y	Y		Y
TENTH - TWELFTH GRADES									
Western Nebraska Observer	Y	Y	Y	Y	Y	Y	Y	Y	Y
Kodak Plant, Windsor, Colo.	Y	Y	Y	Y	Y	Y	Y	Y	Y
ELEVENTH - TWELFTH GRADES									
Forney Transportation Museum	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cummins Power Inc.	Y	Y	Y	Y	Y	Y	Y	Y	Y
Gardner-Denver Corp.	Y	Y	Y	Y	Y	Y	Y	N	Y
TWELFTH GRADE									
Kimball County Hospital	Y	Y	Y	Y	Y	Y	Y	Y	Y
Meyer Photo	Y	Y	Y	Y	Y	Y	Y	Y	Y
Denver Post	N	N	Y	N	Y	N	Y	N	N
United Airlines Transportation Training Center	Y	Y	Y	Y	Y	Y	Y	Y	Y

APPENDIX B

CAREER CORNER

THE CAREER CORNER

April 1975

Hi !

Hope you had a pleasant vacation, in spite of the winter weather, and have returned to the classroom with lots of vim and vigor and anxious to really accomplish many things.

Spring many times brings out the lackadaisical person in us, but it also can bring out the enthusiastic self who is anxious to try new and different activities to motivate others. Have you tried a new approach in your classroom lately ?

The monthly reports show us that more career ed activity was occurring throughout the system during the month of February than in the previous months. The reports are coming back much faster, and we appreciate this. Thank you. The reason for the monthly reports is that I must write a report each quarter describing activities, visitors, etc., related to the program. The main source of this information is the form that you complete. This quarterly report is sent to the program's third party evaluators and to Washington D.C.

When the third party evaluation team visits Kimball, they request "proof" of the activities which have been described in the quarterly reports. We can use the monthly report forms as evidence as well as the many slides we take. Therefore, it is important that you notify Brenda or me before you have a special activity so that slides may be taken.

We do have on file sets of slides and taped narrations to be used in the classrooms showing the bakery, the creamery, banking procedures, county government, and city government. Pam Wilke, junior high home ec student teacher, is currently developing a set of slides with taped narration on the garment industry using the EP-RO Manufacturing Company in Sidney. This set will be available the last of APRIL. Just call us, we'll deliver !!!!

Career Education involves many activities other than field trips and speakers and take much less class time. A five minute class discussion on jobs related to the topic that day may mean a future job for one of the students !!!!!

Attached is Monthly Report Form: List Career Ed Activities for month of MARCH.

Return to your principal by APRIL 11 !!

Till Next Month,

Joan

THOUGHT FOR THE MONTH: NOTHING EVER BECOMES REAL TILL IT IS EXPERIENCED !

Interdisciplinary Education

CAREERS IN DRUG PRODUCTION AND IN DRUG ABUSE PREVENTION

by Charlotte Jones and George Governor

McKeesport Area School District
McKeesport, Pennsylvania

This exceptional unit of work is being used successfully in the McKeesport Area School District, McKeesport, Pennsylvania, with fifth and sixth grade students. It is ingenious because it develops career awareness and, at the same time, without being preachy, makes the students, who are at an age where they are potential drug users, aware of both the benefits of drugs if used properly, and their disadvantages, if misused.

Procedures

Preparation

First, teach the vocabulary necessary for this unit. This would include the following terms: addiction, alcohol, amphetamines, barbiturates, capsule, depressant, drug abuse, glue sniffing, habit, heroin, injection, lysergic acid (LSD), marijuana, overdose, pill, pusher, rehabilitation, side effects, stimulant, tobacco, withdrawal.

Motivation

- If there is a drug manufacturing plant nearby, a trip with the class to visit it is an excellent means of beginning the unit. Follow the normal procedures used in your school to arrange for the trip. When you speak to the plant authorities in regard to the class visit, ask the personnel manager to address the class, describing the various jobs performed by workers.
- If a trip is not possible, write to the large drug companies, asking if they can send a speaker to discuss "careers in the drug industry" with your class. Since almost all drug manufacturers employ people who visit doctors and dentists to make them aware of new products (these people are called "detail men"), the drug companies can easily fill your request. Be sure to explain that you'd like both careers and drugs to be discussed.
- If you can't arrange for either of the above, invite one of the local pharmacists to address the class. Ask

him to discuss the career aspect of the drug industry, including his own. Be sure that he is knowledgeable enough, and capable of handling the speaking assignment by discussing the subject beforehand with him.

- Show filmstrips such as the following: *Facts About Drugs* (filmstrip and cassette), Eye Gate House, 146-01 Archer Avenue, Jamaica, New York 11435. This is a kit which contains six filmstrips—"Facts About Tobacco, Alcohol, Pills and Vapors, Marijuana, Hard Drugs, The World of the Abuser."

Career Background

Most employees in drug production are in research. This includes several stages, one of which is "screening." In this process, a new drug is tested first on bacteria or germ cultures. If it is successful in combating disease, it is then tested on animals. The drug is tested on humans only if it proves to have an advantage over drugs already in use. The good and harmful effects are studied very closely.

Training for Occupations

The training for occupations in the drug industry ranges from a few hours of on-the-job training to years of preparation via undergraduate and graduate study in a university.

For production and maintenance jobs, the industry usually hires inexperienced workers, such as young high school graduates. Many companies encourage their employees to take job-related courses for which they are partially or fully reimbursed.

For technicians, the methods for qualifying for jobs vary greatly with the company. Many technicians enter the field with a high school education, and advance with experience. However, most companies prefer to hire college graduates with science background. The experience required to become a higher level technician varies from one year for an assistant technician, three years for a technician, six years for a senior technician, and ten years for a technical associate. Some companies require senior technicians and technical associates to complete job-related courses.

Biologists, chemists, pharmacists, veterinarians, and physicians are also employed. For most scientific and engineering jobs, a minimum of a Bachelor of Science degree is required. Some companies also have training programs that these people must attend to qualify.

Employment Outlook

The drug industry is a rapidly growing one, and the demand for employees is expected to grow even more rapidly due to the increase in population. The employment in the field is not expected to increase as rapidly as the demand for the product, however, because of automation—especially in manufacturing.

The career of the pharmacist, who brings the drugs to the public, deserves special attention. Pharmacists are college graduates who are in their work responsible for the drugs they sell. If a pharmacist incorrectly fills a prescription, he is responsible. He is also responsible if a prescription is wrong. He must correct it by getting in touch with the physician who wrote it.

Many pharmacists are in business for themselves. Others are employed in hospitals and by other pharmacists.

In regard to drug abuse, some of the careers available are as drug rehabilitation counselors, teachers, and social workers. The counselors and teachers must be college graduates. The social workers may be, but there are many who are not. Often, people who had been addicts themselves will be employed to work with drug addicts.

People who want to go into the field of drug abuse prevention must enjoy working with the less fortunate and must have a real desire to help others.

Activities

Research

The various careers related to the drug production and drug abuse prevention industry should be researched as a class activity. Such concepts as the tasks involved, the importance of the work, and the availability of jobs should be covered.

Sources of information include:

- The *Occupational Outlook Handbook*, U.S. Printing Office, Washington, D.C. 20401.
- Brochures (available at no cost), Pharmaceutical Manufacturers Association, 1155 Fifteenth Street, Washington, D.C. 20005.
- *Marijuana—The Second Grip* by Edward Bloomfirst, Glencoe Press, Beverly Hills, California 90213
- *The Play is Yours: You and Drugs* by Finkel and Krawitz, Ramapo House, Inc., A Division of Universal Publishing & Distributing Corp., New York, N.Y. 10017

It was found that the youngsters enjoy tape recording their research reports. Furthermore, these tape recordings can then become a permanent part of your Career Education Resource Center, and subsequent classes can benefit from the work done by previous groups.

Creative Writing

Have the children select a career in either the area of drug production or drug abuse prevention, and describe their work as they pursued a career in it. Have the children write a report describing how they think they would feel if under the influence of drugs. Have the children write and act out a play showing the methods by which a "pusher" makes new contacts to make sales of drugs.

Letter Writing

Have children write for materials mentioned under Research above. Have the children write a friendly letter

to a local rehabilitation center, telling them about the drug unit they are in the process of undertaking and the purpose behind the unit. They should also ask for any aid the center might be able to provide.

Games

Suggest the development of a game concerning the unit, such as "Get The Pusher." The game can outline police work in the drug field and its development could include another business letter to the local police department concerning their methods of control of illegal drug traffic.

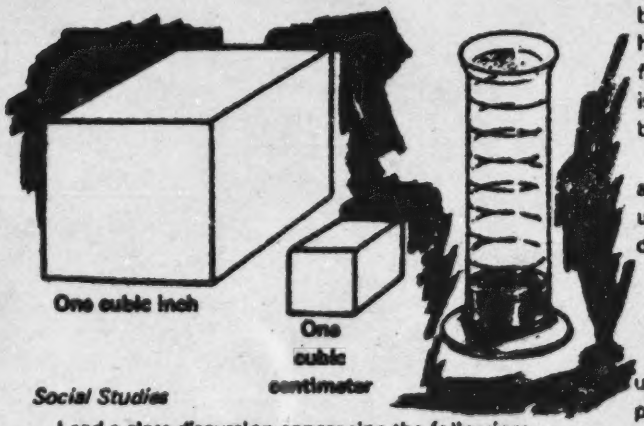
Role Playing

Have the children act out the scenes suggested by the following statements: (1) A career in drug production can be very gratifying (For example, role play a research chemist working in a laboratory who discovers a new drug). (2) Drug counselors or social workers can sometimes help addicts. (3) Some boys and girls try to influence others to take drugs. (4) People often do things to be "one of the crowd." (5) Drug addicts, when faced with a lack of money to support their habits, will do anything to get money.

Tape record the role playing and play back the tapes at the end of the unit. Taping will serve to motivate and also serve as an excellent review.

Mathematics

This unit could be utilized to introduce the measurement of very small volumes. For instance—cubic centimeters: To introduce the concept, it could be explained that drugs in liquid form are measured in cubic centimeters. In order to grasp the concept of the minute size of a cubic centimeter, the children should be allowed to measure them with either a syringe or a small graduated cylinder.



Social Studies

Lead a class discussion concerning the following:

- The positive aspects of drugs. Discuss the contribution of drugs, when used appropriately, to the health of the human race. For example, the students can do research on the miracles wrought by penicillin. Illnesses which once were plagues, such as tuberculosis, have been almost wiped out as a result of modern medicines. New drugs are constantly being developed to help save lives.
- How the heroin addict's need for money to support his habit can lead to higher insurance rates for robbery in the community.
- The origins of a great deal of heroin and marijuana (Turkey and Mexico respectively), and the economics involved in the high cost of the products when they are finally sold on the street.
- How social workers and drug rehabilitation counselors help those people who are addicted to drugs. Point out the number of ex-addicts who go into careers of this type because of their own experience.

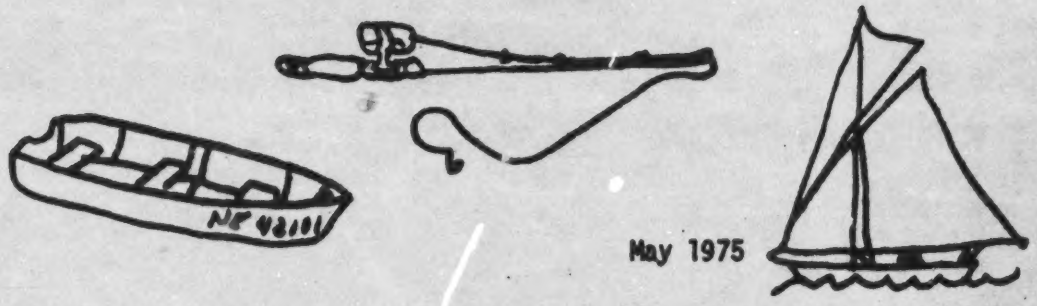
Science

The students should discuss the various physical effects drugs have on the human body.

- Amphetamines speed up the body processes. If too much of an amphetamine is taken, or if it is taken over a long period of time in large amounts, the major organs could possibly fail.
- Barbiturates slow down body functions; if too much of a barbiturate is taken, or if it is taken over a long period of time, the organs may slow down too much to support the life within them.
- The vapors in some glues, when absorbed into the bloodstream through the lungs, attack brain tissue, often causing permanent brain damage.
- LSD, when absorbed by the bloodstream, upsets the chemical balance in the brain, causing hallucinations. If the person using the drug is emotionally disturbed, this upset can become permanent.
- Heroin is a depressant and painkiller and the danger of its use does not lie in the drug itself—but in its physically addictive qualities. The major organs of the body actually undergo chemical changes, after which the heroin is actually needed in order for them (organs) to function properly. The major danger from the drug itself is (if an overdose is taken) that the organs may fail because of the drug's depressant qualities.
- There has been no major physical problem found, as yet, concerning the use of marijuana. However, its users tend to become emotionally dependent upon the drug.

Conclusion

This unit proved to be very effective. The methods used, especially the reports on the tapes and the role playing activities, were especially valuable. The children realized, at the end of the unit, that drugs are useful as well as an object of abuse, and that there were many careers open for consideration by them in the field of drug production and drug abuse prevention.



T
H
E
CAREER CORNER

May 1975

Hi !

Just a short note to finish up the school year !

Many activities have occurred during this past year which have exposed students to many careers other than those they would normally have observed. These activities should have made the classroom work more meaningful and relevant. I hope you plan to continue these experiences as well as doing some revision and expansion in other areas to include some career education information.

Accompanying this issue of The Career Corner are several "goodies" which we hope you will fill out for our use this summer as we plan for next fall. The information that you give to us will be used by other faculty members as they plan experiences for next year.

We have several ideas for teacher related activities for next fall to assist those who are having difficulties including career ed into their curriculum. Only a few final touches need to be added.

Each of the elementary and junior high libraries has received some new career education materials during the past few weeks. Rather than list them now when you probably won't be using them, I will include them in a listing for next fall.

Thank you for your interest, work and assistance in the career education project this year.

Have a great summer !

See you next fall.

Joan

THOUGHT FOR THE MONTH:

Career education involves all subjects, all students, all educators and the total community.

APPENDIX C

SUMMARY OF THE MONTHLY REPORT FORMS

ELEMENTARY CAREER EDUCATION

FROM APRIL 1, 1975 - JUNE 30, 1975

I. UNITS TAUGHT

A. Kindergarten
   1. West - Willie, the Worker Watcher filmstrips; greenhouse, Farming.
   2. Mary Lynch - Post Office, Bakery

B. 1ST Grade
   1. West - Bank; Dairy; Circus; Factory
   2. Mary Lynch - Economic Awareness

C. 2ND Grade
   1. West - Construction Workers; City Workers; Community Helpers (policeman, fireman)
   2. Mary Lynch - Policeman; Fast Food Restaurant

C. 3RD Grade
   1. West - Soil Conservation; Tacoma Washington, lumber industry; Hawaii, pineapple industry
   2. Mary Lynch - None

D. 4TH Grade
   1. West - Japan: related occupations, farming, fishing, manufacturing
   2. Mary Lynch - None

E. 5TH Grade
   1. West - Careers related to Arts and Humanities; Government; Telephone Industry
   2. Mary Lynch - Blacksmith; State government; Telephone workers; Ministry; Television technician

F. Special Reading
   1. Bulletin board with dolls representing different careers.
   2. Each student picked a career and carried out a reading related activity associated with the job.

G. Music
   1. Careers in Music

H. Guidance
   1. Grades 4 and 5 - Working Together
   2. Grades 2 and 3 - Pantomimed various careers

I. Physical Education
   1. Careers related to the sport of track

II. FIELD TRIPS

A. Kindergarten
   1. West - Gar-B Greenhouse; Easton's farm
   2. Mary Lynch - None

B. 1ST Grade
   1. West - Dairy Farm; First State Bank, Factory
   2. Mary Lynch - Gar-B Specialties;

C. 2ND Grade
   1. West - None
   2. Mary Lynch - McDonalds in Scottsbluff

D. 3RD Grade
   1. West - None
   2. Mary Lynch - None

E. 4TH Grade
   1. West - None
   2. Mary Lynch - None

F. 5TH Grade
   1. West - Trip to Cheyenne, Wyoming to visit the State Capitol and the Bell Telephone Company
   2. Mary Lynch - Trip to Cheyenne, Wyoming to visit the State Capitol and the Bell Telephone Company; Blacksmith north of Potter, Nebraska

III. RESOURCE PEOPLE

A. Kindergarten
   1. West - Bev Inman
   2. Mary Lynch - None

B. 1ST Grade
   1. West - Mrs. Phil Schwindt; Jerry Andersen
   2. Mary Lynch - Bev Inman

C. 2ND Grade
   1. West - Policemen
   2. Mary Lynch - Paul Manley, Nebraska State Patrol; Rich Wangler, Chief of Kimball Police

D. 3RD Grade
   1. West - Mr. Buresh from the ASCS Office
   2. Mary Lynch - None

E. 4TH Grade
   1. West - None
   2. Mary Lynch - None

F. 5TH Grade
   1. West - None
   2. Mary Lynch - Shorty Mayer; Mrs. Griffin and Mrs. Fitch

JUNIOR HIGH CAREER EDUCATION

FROM APRIL 1, 1975 - JUNE 30, 1975

I. UNITS TAUGHT

A. Special Education
   1. Savings Account
   2. Jobs in Kimball

B. Physical Education and Health
   1. Emergencies
   2. Fire

C. Sixth Grade
   1. Golf
   2. Aquarium Construction
   3. Geology
   4. Speech
   5. Road Map Use to extend math skills and concepts
   6. General examination of careers related to math
   7. Canada - occupations - future possibilities
   8. Energy Uses
   9. Examination of nine different job duties and assignments-using puppets to illustrate each career

D. Seventh Grade
   1. Acids, bases, salts - relating these to jobs at the ASCS office
   2. Force and work
   3. Crochetting
   4. Field surveying
   5. Central and Eastern Asia - wheat marketing
   6. Austrialia - New Zealand - fishing, etc.
   7. Cartoonist

E. Eighth Grade
   1. Nervous system and human heredity
   2. Diseases, tobacco, alcohol and narcotics, nutrition, evolution, ecology, conservation
   3. Basketball officiating
   4. Service and cartoon advertisements
   5. Metric measure - social applications
   6. Stock market
   7. Military careers
   8. Sewing
   9. Cake decorating
   10. Brick laying
   11. Sheet metal

II. FIELD TRIPS

A. Special Education
   1. Kimball Branch of Sidney Federal Savings and Loan
   2. Missle Site
   3. Stanco Oil Company Oil Field

B. Sixth Grade
   1. Missle Site
   2. Golf Course
   3. Stanco Oil Company Oil Field
   4. Head Start School - Puppet Workshop

C. Seventh Grade
   1. ASCS Office
   2. Horseshoe Hill for surveying
   3. Kawaskai Sales
   4. Co-Op Grain Elevator
   5. Fishing Trip

D. Eighth Grade
   1. Western Nebraska Technical College
   2. Home Economics teacher developed a slide and tape presentation on a clothing factory in Sidney

III. RESOURCE PEOPLE

A. Special Education
   1. Savings and Loan Employees
   2. Mr. Stan Juelfs and field operators

B. Physical Education and Health
   1. Fire department

C. Sixth Grade
   1. Stan Juelfs and field operators
   2. Two puppeteers from Chadron State College
   3. Staff at Missle Control Center

C. Seventh Grade
   1. ASCS office personnel
   2. Kawasaki Salesman
   3. Florian Brown and Hubert Kohlmeier at the Co_op Grain Elevator

D. Eighth Grade
   1. Dale Hendrickson
   2. Merceda Dietz
   3. Arnie Christensen
   4. Mr. Gene Phillips

HIGH SCHOOL CAREER EDUCATION

FROM APRIL 1, 1975 - JUNE 30, 1975

I. UNITS TAUGHT

A. Reading
   1. Careers: A Supplemental Reading Program
   2. Wrote letters of Application

B. English
   1. Investigating a career of your choice
   2. Study of careers in drama in relation to The Odyssey

C. Business
   1. Actual job-typing experiences
   2. Banking Services
   3. Job Interviews and Applications

D. Industrial Arts
   1. Projects

E. Vocational Agriculture
   1. Electricity
   2. Surveying
   3. Livestock and Dairy Judging

F. Auto Mechanics and Machine Shop
   1. Auto and truck repairing

G. Home Economics
   1. Clothing construction - girls
   2. Cooking skills - boys

H. Science
   1. Paleontology
   2. Gardening and all of the related gardening crafts
   3. Veterinary Science
   4. Photo manufacturing

I. Math
   1. Insurance
   2. Working with money - buying and selling
   3. Work involvement in auto body work

J. Foreign Language
   1. School systems

K. Music
   1. Performance work including choreography

L. Physical Education
   1. Tennis, badminton, ping-pong, golf as avocations

M. Social Studies
   1. Adjusting to your social environment

N. Art
   1. Art skills used as an avocation

II. FIELD TRIPS

A. Reading - None

B. English - None

C. Business - None

D. Industrial Arts - None

E. Vocational Agriculture
   1. Tri-State Livestock Exposition at Kimball

F. Auto Mechanics and Machine Shop
   1. Trip to Denver to visit various shops

G. Home Economics - None

H. Science - None
   1. Kodak plant at Winsor, Colorado

I. Math
   1. Kimball Body Works

J. Foreign Language - None

K. Music - None

L. Physical Education - None

M. Social Studies - None

N. Art - None

III. RESOURCE PEOPLE

A. Reading - None

B. English - None

C. Business
   1. Mrs. June Nielsen
   2. Bonnie Koch

D. Industrial Arts - None

E. Vocational Agriculture - None

F. Auto Mechanics and Machine Shop - None

G. Home Economics - None

H. Science - None

I. Math
   1. Johnny Wynne
   2. Bruce Madden

J. Foreign Language - None

K. Music - None

L. Physical Education - None

M. Social Studies - None

N. Art - None

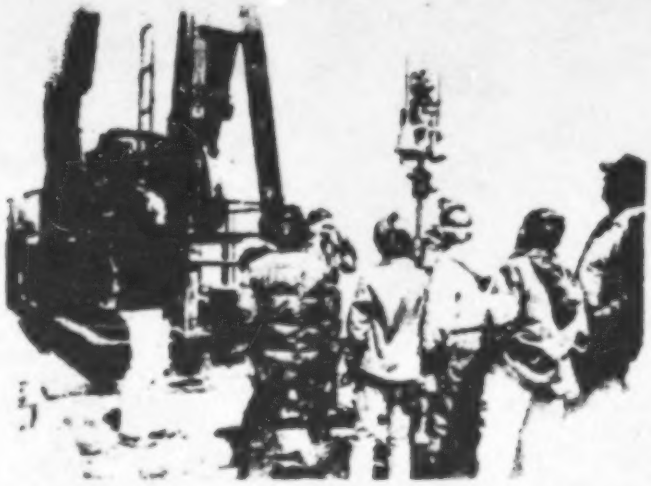
APPENDIX D

DISSEMINATION ACTIVITIES

SHORTHORN CORRAL

News from Junior High School

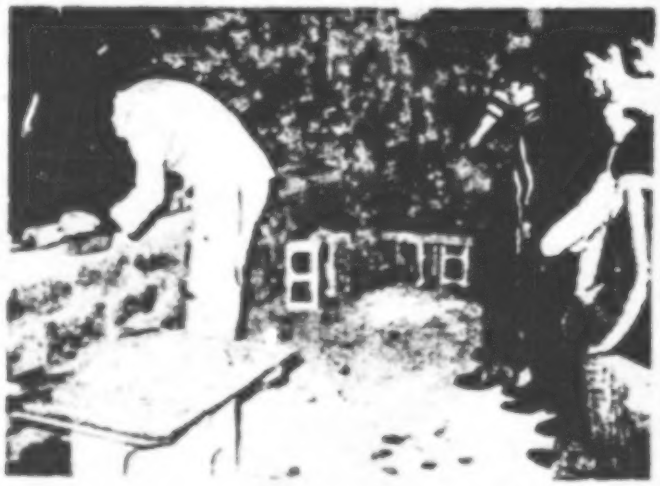
Thursday, April 10, 1975



OIL FIELD TRIP
By Laurie Burke

On April 24 the 8th grade took a trip to the Enders Oil Company.

Mr. Hoffman, our science teacher, has been teaching us geology which includes the study of oil. On the field trip we learned many different things. Mr. Juelfs, Mr. McDonald and Mr. Britton showed us the grounds. We saw everything from the pumps bringing up the oil from underground to the pipes sending the processed oil to Illinois.



EIGHTH GRADE TOUR
By Rick Soper

On April 14 all the 8th grade shop members went to Western Nebraska Vocational Technical School to see and learn about brick laying. We also learned which kinds of bricks and mortar to use on a certain job. After the brick laying class we saw several different aircrafts. The next 2 days Mr. Greenlee arranged for each class to meet 2 hours, and we laid brick during those 2 days under the supervision of Mr. Greenlee.

STUDENTS AT THE COOP GRAIN ELEVATOR

On April 23 the 7th grade history class visited the Kimball County Grain Coop Elevator. Florian Brown and staff showed us how grain is sold and graded. We learned that 90 percent of the grain is exported, and that most of our wheat goes to Denver and most of our beans go to New York. Mr. Brown showed us all about testing the grain. The staff showed us how grain is cleaned and where it is stored.

VISITORS IN 7TH GRADE HISTORY CLASS
By Damen Debewey

On April 22 Hubert Kohlmier and Florian Brown came to visit the 7th grade history classes. They spoke to us about cooperatives. It tied in with our study on Asia, and the exporting of grain to Japan, Taiwan and South Korea.

They also showed us a film to help us understand how a cooperative works, and the way grain is sold.

Mini-classes

...varied talents

EVEN BOYS were interested in the baking mini-courses at Kimball Junior High School this week as shown in this scene in the first stages of a cake project.—Observer photo

VISIT FROM OBSERVER
By Teri Callier

Mr. Russell from the Observer, came to Mr. Whartman's 8th grade English class to talk about advertising for the Observer.

Mr. Whartman's class is studying Creative Writing and are on the unit of advertising. He talked about what catches the publics eye, how much schooling it takes and what training it requires.

He talked about the different types of advertisement in the Observer and how long it takes to put the paper together.

It proved to be very interesting.

COACH BILL CARROLL taught a course during mini-classes on basics of athletic training, including bandages for common sprains and pulled muscles.—Observer photo

ACCESSION NUMBER: VT102558

PUBLICATION DATE: OCT75

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PERSONAL AUTHOR: STAKELON, ANNE E., COMP.; MAGISOS, JOEL H., COMP.

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IDENTIFIER: VOCATIONAL EDUCATION AMENDMENTS OF 1968

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ABSTRACT: THIS ANNOTATED BIBLIOGRAPHY WAS PREPARED TO ASSIST THOSE APPLYING FOR GRANTS UNDER PART D OF THE VOCATIONAL EDUCATION ACT OF 1963, AS AMENDED. THE BIBLIOGRAPHY IS INTENDED TO HELP APPLICANTS PLAN AND CONDUCT BETTER PROJECTS AS A RESULT OF KNOWING ABOUT COMPLETED AND ONGOING RESEARCH. COMPUTER-ASSISTED SEARCHES OF SEVERAL DATA BASES RECOVERED ITEMS RELATED TO THE CONCEPTS AND EVALUATION OF WORK EXPERIENCES, COOPERATIVE EDUCATION, OR YOUTH MANPOWER PROGRAMS, OF WHICH 106 WERE CHOSEN TO BE INCLUDED IN THE DOCUMENT. SECTION TITLES ARE ERIC REPORT LITERATURE, AIM/ARM REPORT LITERATURE, NTIS REPORT LITERATURE, JOURNAL ARTICLES, AND PROJECTS IN PROGRESS. INFORMATION ABOUT HOW TO ORDER DOCUMENTS IS ALSO PROVIDED. (LJ)

AVAILABILITY: CENTER FOR VOCATIONAL EDUCATION, OHIO STATE UNIVERSITY, 1960 KENNY ROAD, COLUMBUS, OHIO 43210. (ORDER NO. BB28, $4.00 EA.; COMPLETE SET OF THREE, ORDER NO. BB27-29, $10.00 PER SET.)

INSTITUTION NAME: OHIO STATE UNIV., COLUMBUS. CENTER FOR VOCATIONAL EDUCATION.

SPONSORING AGENCY NAME: BUREAU OF OCCUPATIONAL AND ADULT EDUCATION

102 558

Bibliography Series No. 28

Evaluation of Work Experience, Cooperative Education, and Youth Manpower Programs

An Annotated Bibliography

THE CENTER FOR VOCATIONAL EDUCATION
The Ohio State University • 1960 Kenny Road • Columbus, Ohio 43210

2

Bibliography Series No. 28

EVALUATION OF WORK EXPERIENCE, COOPERATIVE EDUCATION, AND YOUTH MANPOWER PROGRAMS: AN ANNOTATED BIBLIOGRAPHY

Compiled by

Anne E. Stakelon and Joel H. Magisos

The Center for Vocational Education
The Ohio State University
1960 Kenny Road, Columbus, Ohio 43210

October 1975

This publication was prepared pursuant to a contract with the Bureau of Occupational and Adult Education, U.S. Department of Health, Education and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their judgement in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official Bureau of Occupational and Adult Education position or policy.

PREFACE

This annotated bibliography was prepared by the AIM/ARM project at The Center for Vocational Education for the U.S. Office of Education in response to a request by Joyce D. Cook in the Demonstration Branch. It is made available on a cost-recovery basis to assist possible applicants for grants under the Vocational Education Exemplary Program of the Office of Education for fiscal year 1976 (Part D of the Vocational Education Act of 1963, as amended). Advance notice of priorities, subject to changes in legislation, appropriations, or program plans, was given in the *Federal Register*, Vol. 40, No. 139, Friday, July 18, 1975 (pages 30297-8).

It is hoped that this bibliography and its companions, *Experienced Based Career Education: An Annotated Bibliography* and *Sex Stereotyping and Occupational Aspiration: An Annotated Bibliography*, will help applicants plan and conduct better projects as a result of knowing about completed and ongoing research. Project directors are encouraged to send information about projects to AIM/ARM.

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INTRODUCTION

Experience based career education has been designated as the priority for projects under the USOE Vocational Education Exemplary Program for fiscal year 1976. Special emphasis was to be given to elimination of sex bias and sex role stereotyping and to evaluation of projects. To avoid duplication and to build upon prior knowledge, literature in the field should be considered.

The reports and journal articles cited in this bibliography were found through computer-assisted searches of *Abstracts of Instructional and Research Materials in Vocational and Technical Education* (AIM/ARM), *Resources in Education* (RIE), *Current Index to Journals in Education* (CIJE), and the National Technical Information Service (NTIS) data base. Items included were those found to be indexed with one or more terms from the concepts listed below. All ERIC and AIM/ARM citations were limited to those containing these index terms as major descriptors.

ERIC and AIM/ARM Citations

CONCEPT	INDEX/SEARCH TERMS
Work Experience, Cooperative Education, or Youth Manpower Programs	Apprenticeships Cooperative Education Cooperative Programs Field Experience Programs Industrial Training Inplant Programs Internship Programs Job Corps Neighborhood Youth Corps Off The Job Training On The Job Training Student Employment Work Experience Work Experience Programs Work Study Programs

Evaluation	Curriculum Evaluation Efficiency Evaluation Evaluation Criteria Evaluation Methods Evaluation Needs Evaluation Techniques Formative Evaluation Program Evaluation Summative Evaluation

A total of one-hundred and ninety ERIC and AIM/ARM citations were found using the search strategy outlined above and seventy-nine items have been included in this publication.

NTIS Citations

CONCEPT	INDEX/SEARCH TERMS
Work Experience, Cooperative Education, or Youth Manpower Programs	Cooperative Education and Youths Job Corps Manpower Development and Youths Manpower Utilization and Youths Neighborhood Youth Corps Personnel Development and Youths Work Experience and Youths
Evaluation	Appraisals Assessment Assessments Evaluation Performance Evaluation

Forty-nine NTIS documents were found to have the above search terms within their citations. Twenty-seven have been included as relevant to the subject under consideration.

Citations have been organized in four sections—ERIC Report Literature, AIM/ARM Report Literature, NTIS Report Literature, and Journal Articles. Annotations within each section have been arranged by latest accession number (i.e., ED, VT, PB, and EJ numbers in descending order). NTIS order numbers appear on the last line of each citation. The final section lists Projects in Progress that were reported in AIM/ARM.

ERIC REPORT LITERATURE

ED099060 JC740501

L.P.N. STUDENTS EVALUATE COOPERATING AGENCY EXPERIENCES.

Grippando, Gloria M.

Nova Univ., Fort Lauderdale, Fla.

Pub Date Oct 74 Note-27p.; Practicum submitted to Nova University in partial fulfillment of requirements for Doctor of Education degree

EDRS Price MF-$0.75 HC-$1.85 PLUS POSTAGE

Descriptors - Clinical Experience/*Community Colleges/*Cooperative Programs/*Nurses/Post Secondary Education/*Practical Nursing/Practicums/*Program Evaluation/Rating Scales/School Community Relationship/Student Attitudes

Identifiers - *College of Lake County/Illinois

This study examined the relationship between clinical laboratory experiences in 19 local cooperating agencies and the philosophy of the College of Lake County Licensed Practical Nursing Program. The subjects were 27 female LPN students, ages 18-44, who completed an evaluative form consisting of 10 items. The items were evaluated on a 1 to 5 rating scale, indicating a poor to superior rating. The overall results showed that seven agencies have a mean of less than 3.0 average. Recommendations are made in light of the findings. (An appendix presents the rating form.) (DB)

ED097048 JC740370

AN EXAMINATION OF THE FEDERAL COLLEGE WORK-STUDY PROGRAM AT MONTEREY PENINSULA COLLEGE.

Bobrow, William

Pub Date 74 Note-71p.; Master's Thesis, The Monterey Institute of Foreign Studies

EDRS Price MF-$0.75 HC-$3.15 PLUS POSTAGE

Descriptors - *Disadvantaged Youth/Employer Attitudes/*Federal Programs/*Junior Colleges/ Masters Theses/Post Secondary Education/*Program Evaluation/Questionnaires/Student Attitudes/ Student Needs/Vocational Education/*Work Study Programs

Identifiers - California/*Monterey Peninsula College

The work-study program at Monterey Peninsula College was evaluated through questionnaires distributed to students in the program and to their supervisors. In particular, the issues involved in work-study education as related to disadvantaged students were examined. Analysis of the questionnaire data revealed that the work-study students felt that they were gaining skills and were learning. They expressed the need for more training and opportunity to learn, and felt that supervision was important to their working experience. The need for more information and counseling from the placement office was also indicated by the students. Supervisors felt that they were providing

training and that the students had good attitudes and work habits. The major problems as seen by the supervisors were the students' attendance and punctuality. Some supervisors felt that they should offer better training and counseling and that they needed more information on the students and on the work-study procedures. Most employers felt that the program was providing a learning experience for the students as well as financial aid and that it was aiding the employer by supplying manpower. Some supervisors felt the students were not properly motivated and indicated problems existed with hours and allocations of work-study students. (Copies of the Student Questionnaire and Supervisor's Questionnaire are provided.) (DB)

ED094051 UD014396

RESTRUCTURED NEIGHBORHOOD YOUTH CORPS OUT-OF-SCHOOL PROGRAM IN URBAN AREAS. DEPARTMENT OF LABOR. REPORT TO THE CONGRESS.

Comptroller General of the U.S., Washington, D.C.

Report No.-B-130515

Pub Date 2 Apr 74 Note-46p.

Available from - U.S. General Accounting Office, Room 6417, 441 G Street, N.W., Washington, D.C. 20458 (B-130515, $1.00)

EDRS Price MF-$0.75 HC-$1.85 PLUS POSTAGE

Descriptors - Case Studies/Community Agencies (Public)/Dropout Programs/Federal Programs/*Job Placement/Job Training/Out-of-School Youth/*Program Evaluation/Urban Youth/Work Experience Programs

Identifiers - Alabama/California/*Neighborhood Youth Corps/Ohio/Pennsylvania/Texas

In January 1970, the Department of Labor restructured its Neighborhood Youth Corps (NYC) out-of-school program and made age limits for entering the program more restrictive. Education, skill training, and work experience were emphasized. The restructured NYC-2 program was carried out in urban or growth areas, but the original NYC-1 program was continued in the remaining locations in the country. To test whether the department's restructuring had improved the program, the General Accounting Office (GAO) reviewed five NYC-2 projects in Birmingham, Cleveland, Philadelphia, San Antonio, and San Francisco. In 1969 GAO reported to the Congress that the NYC initial out-of-school program was essentially a work experience program serving as a temporary holding action until enrollees could find better jobs or secure training through other federal or local programs. GAO questioned the need for the out-of-school program operated at that time because of the availability of other programs to meet enrollees needs. The restructured out-of-school program objectives were to place enrollees in suitable jobs, advanced training, or further education after they leave the program. Community sponsors, such as public or private nonprofit agencies, plan, administer, coordinate, and evaluate the program. (Author/JM)

ED092598 TM003711

EVALUATION OF THE MUNICIPAL COOPERATIVE EDUCATION PROGRAM: A REPORT OF THE 1962-63 TRAINEES.

Vambery, Eva

Center for Urban Education, New York, N.Y.

Spons Agency - Ford Foundation, New York, N.Y.

Pub Date 30 Oct 67 Note-158p.; This study was administered by the Department of Personnel and the Board of Education of the City of New York; For related document, see ED 041 958

EDRS Price MF-$0.75 HC-$7.80 PLUS POSTAGE

Descriptors - *Cooperative Education/Cooperative Programs/Follow-up Studies/*High School Students/Job Skills/Occupational Aspiration/*Program Evaluation/Vocational Adjustment/Work Attitudes/Work Study Programs

Identifiers - New York City

A summary of a year long evaluation of the participants in the 1962-63 Municipal Cooperative Education Program (MCEP) is presented. The MCEP is a work-study program for high school students in New York City which affords participants an opportunity to engage in vocational experimentation under structured and supervised conditions while continuing their education. This evaluation determines what effects, if any, participation in the program had on the student, and comments on these effects in terms of the intended and expected outcomes of program participation. The data was collected through interviews and questionnaires from 48 cooperative and 21 control students. The findings of the study conclude that: (1) the MCEP enhanced the high school curriculum; (2) the value of the vocational experience was determined greatly by the nature of the work assignment; (3) the trainees were at a disadvantage by being placed in special classrooms apart from other students; and (4) the trainees need counseling while participating in the program, as well as at the time of study. The appendixes include samples of correspondence with respondents, research instruments used, information about the data, and tabulated data from questionnaires. (MLP)

ED091454 UD014182

AN EVALUATION OF THE HIGH SCHOOL REDIRECTION PROGRAM. STATE URBAN EDUCATION PROGRAM.

New York Univ., N.Y. Center for Field Research and School Services.

Spons Agency - New York City Board of Education, Brooklyn, N.Y.

Pub Date Jul 73 Note-70p.; Function No. 17-36455

EDRS Price MF-$0.75 HC-$3.15 PLUS POSTAGE

Descriptors - Academic Achievement/Attendance Records/Dropout Identification/*Dropout Prevention/Dropout Programs/High Schools/High School Students/*Program Evaluation/Remedial Instruction/Summer Programs/*Urban Schools/Vocational Education/Work Experience Programs/ *Work Study Programs

Identifiers - *New York City

The High School Redirection Program was designed to maintain 240 potential dropouts in an educational-vocational setting while assisting them to progress toward a high school diploma. Students were admitted from 13 high schools in Brooklyn and from Andrew Jackson in Queens. They were to follow a work-study program through the summer and regular academic year combining selected classes for academic credit and paid work experience in alternate weeks. After five months of intensive research, the following findings required by the Evaluation Design were reported: (1) it is apparent that the overall program objective seeking to redirect dropouts and potential dropouts toward meaningful educational and vocational goals is being achieved; (2) academic achievement goals measured by the successful completion of courses as established in the original proposal are being met; (3) attendance achievement goals established in the original proposal are being met; (4) specific remedial reading and mathematics goals determined by standardized tests as established in the original proposal are being met; (5) academic achievement goals measured by teacher-made tests as established in the original proposal are being met; and (6) vocational (work experience) goals established in the original proposal are being met. (Author/JM)

ED081998 CE000242

EXECUTIVE SUMMARY; AN ASSESSMENT OF SCHOOL-SUPERVISED WORK EDUCATION PROGRAMS.

Frankel, Steven M.

System Development Corp., Santa Monica, Calif.

Spons Agency - Office of Education (DHEW), Washington, D.C. Office of Planning, Budgeting, and Evaluation.

Report No.-SDC-TM-5195-003-00

Contract-OEC-0-72-5024

Pub Date 14 Sep 73 Note-30p.; For related documents see CE 000 241, CE 000 243, and CE 000 244

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Cooperative Education/Dropout Prevention/Models/On the Job Training/Predictor Variables/*Program Evaluation/Statistical Analysis/*Vocational Education/*Work Experience Programs/*Work Study Programs

Identifiers - *Work Education Evaluation Project

This document summarizes the significant findings, overall methodology, and policy recommendations for the Assessment of School Supervised Work Education Programs. It consists of material contained in the Data Analysis Report together with a description of the analysis model developed for each respondent group. Individual predictor items were related to outcome measures by cross tabulation and tested for statistical significance and strength of association by chi square and other measures to determine which program components have a major impact on program success. (MS)

ED081985 CE000218

ON-THE-JOB ORIENTATION OF UNEMPLOYED NEGRO SKILL CENTER TRAINEES AND THEIR SUPERVISORS. FINAL REPORT.

Rosen, Hjalmar

Wayne State Univ., Detroit, Mich.

Spons Agency - Manpower Administration (DOL), Washington, D.C. Office of Research and Development.

Report No.-DLMA-81-24-68-35

Pub Date 1 Jun 70 Note-167p.

Available from - National Technical Information Service, Springfield, Va. 22151 (PB-192 568, MF $1.45)

Document Not Available from EDRS.

Descriptors - *Employer Employee Relationship/Females/*Negroes/*On the Job Training/Orientation/*Program Evaluation/Role Playing/*Skill Centers/Supervisors/Trade and Industrial Education/Unemployed/Work Attitudes

The problems inherent in employing hard-core unemployed Negroes and the optimal locus of on-the-job orientation to integrate such employees into the work force were subjects of this study. It focused on young Negro females who, because of their inability to meet selections minimums for job entry, had a high potential for chronic unemployment. Among the conclusions of the study were that sanctions for absenteeism in a training center cannot parallel these on-the-job, that there is a serious question whether utilization of any on-the-job orientation is desirable to integrate the special employee into the world of work, that management's concern is apt to be more with organizational welfare than societal, and that intervention with normal work schedules for skill training sessions will create antagonism among company personnel. This project used role playing questionnaires, demographic surveys and other techniques which are fully reported in the second section. (MS)

ED081933 CE000163

AN ECONOMIC ANALYSIS OF THE JOB CORPS.

Engleman, Stephen Robert

California Univ., Berkeley. Inst. of Industrial Relations.

Spons Agency - Manpower Administration (DOL), Washington, D.C. Office of Research and Development

Report No.-DLMA-91-05-69-53-1

Pub Date Aug 71 Note-184p.; Ph.D. dissertation, University of California, Berkeley

Available from - National Technical Information Service, Springfield, Va. 22151 (PB-202 891, HC $3.00, MF $1.45)

Document Not Available from EDRS.

Descriptors - *Age Differences/Cost Effectiveness/*Disadvantaged Youth/*Economic Research/Individual Characteristics/Job Tenure/Multiple Regression Analysis/*Program Evaluation/*Racial Differences

Identifiers - *Job Corps

This dissertation considered the experience of various groups that participated in the Job Corps both during and after their stay in Job Corps. Considerable differences were found between the various race/age and race/religion groups considered. All groups, however, received benefits in excess of costs, with the Benefit/Cost ratios found ranging from 1.96 for the older non-whites to 3.72 for the older whites. The dissertation also includes extensive analyses of the determinants of length of stay in the program, as well as the determinants of post Job Corps earnings. Multiple regression analysis was the primary analytic tool utilized for these purposes. Also, a bibliography is included. (NTIS)

ED080692 VT020939

DIFFICULTIES OF THE NEIGHBORHOOD YOUTH CORPS IN-SCHOOL PROGRAM AND ITS MANAGEMENT PROBLEMS. REPORT TO THE CONGRESS.

Comptroller General of the U.S., Washington, D.C.

Report No.-B-130515

Pub Date 20 Feb 73 Note-55p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Disadvantaged Youth/*Dropout Prevention/Dropout Programs/Federal Programs/Job Training/Management/*Program Evaluation/Surveys/Vocational Development/*Work Experience Programs/*Youth Employment/*Youth Programs

Identifiers - *Neighborhood Youth Corps/NYC

This document reports the results of a study to determine whether changes made in the Neighborhood Youth Corps' in-school component helped to decrease the school dropout rate among participants. Surveys of programs in Harris County, Texas, Norfolk, Virginia, and the Washington metropolitan area provided the data. Overall findings suggest that the in-school program has not changed dropout tendencies, indicating therefore that this component of the program has no significant effects on whether disadvantaged youth remain in school. Difficulties of the program and its problems are discussed in detail. (SN)

ED079555 VT020863

COOPERATIVE WORK EXPERIENCE EDUCATION—A STUDY IN SUCCESS: TWENTY-SIX TO FORTY YEARS LATER.

Brockmann, L. O.

Pub Date 72 Note-108p.

Available from - Titan Bookstore, California State University, Fullerton, CA 92634 ($4.00)

EDRS Price MF-$0.65 HC-$6.58

Descriptors - *Cooperative Education/Employer Employee Relationship/Employment/Follow-up Studies/*Graduate Surveys/Income/Occupational Choice/*Program Effectiveness/*Program Evaluation/Success Factors/*Work Experience

This study was undertaken to provide an analysis of the reactions of students toward a cooperative work experience education program 26 to 40 years later. Major emphasis was placed on topics such as vocational choice, getting and holding a job, human relations, citizenship education, related instruction, education beyond high school, jobs held since graduation, armed services participation, and income range. Data from 423 respondents (approximately 75 percent) revealed that: (1) The greatest value of the program was in human relations, especially employer-employee relations and the development of personality and poise, (2) In assisting the participants make a vocational choice, the program ranged from somewhat to extremely helpful in 73.7 to 92.3 percent of the situations, (3) Employment stability was average or better, with approximately 60 percent remaining in the same field for which they had been trained, (4) In the area of getting and holding a job, the program was somewhat to extremely helpful in 64.8 to 94.3 percent of the situations, and (5) The salaries earned by the former students were modest, with 10.9 percent earning over $20,000 per year. A sample survey instrument is appended. (SB)

ED076751 VT020070

STAYING IN SCHOOL: AN EVALUATION OF A PROGRAM TO PREVENT SCHOOL DROPOUTS. FINAL REPORT.

Berkowitz, Louis, ed.; et al.

Educational Alliance, Inc., New York, N.Y.

Spons Agency - Social and Rehabilitation Service (DHEW), Washington, D.C.

Report No.-SRS-12-55024-2

Pub Date 71 Note-128p.

Available from - National Technical Information Service, Springfield, Va. 22151 (PB 214 492, MF-$.95, HC-$3.00)

Document Not Available from EDRS.

Descriptors - Affective Behavior/Changing Attitudes/*Counseling Programs/Demonstration Projects/Disadvantaged Youth/*Dropout Prevention/Job Placement/Job Training/Program Effectiveness/*Program Evaluation/*School Community Programs/Secondary Grades/Social Welfare/Student Motivation/Urban Areas/*Work Experience Programs/Youth Programs

Identifiers - *New York City

This demonstration project in New York City undertook to help potential dropouts remain in school through the introduction of a program which combined after-school work experience with group and individual counseling. Concomitantly, it sought to develop an effective intervention methodology for replication in other communities. The principal intervention strategy involved maximizing the role of an autonomous, community-based social agency with varied public agency

contacts and diverse facilities and programs. Through the integration of several social work approaches, which combined specific methodologies of adjustment, advocacy, and accommodation, pupils were aided in adjusting to the educational environment while at the same time mediation with the school system was established. (Author/SN)

ED076735 UD013577

ANNUAL REPORT: DETROIT PUBLIC SCHOOLS JOB UPGRADING PROGRAM, 1971-1972. THE JOB UPGRADING PROGRAM MANUAL OF PROCEDURE AND CURRICULUM GUIDE, SECOND EDITION.

Detroit Board of Education, Mich.; Detroit Public Schools, Mich.

Pub Date Dec 72 Note-144p.

EDRS Price MF-$0.65 HC-$6.58

Descriptors - Compensatory Education Programs/Counseling Programs/Curriculum Development/Disadvantaged Youth/Dropout Prevention/*Dropout Programs/Dropout Rehabilitation/*High School Students/Inner City/*Program Evaluation/Vocational Education/*Work Experience Programs

Identifiers - Detroit/Elementary Secondary Education Act Title I/ESEA Title I/*Michigan

The Job Upgrading Program helps school dropouts and potential dropouts either return to or adjust to the regular school program or become prepared for the world of work. Trainees are given the opportunity to take an abbreviated school program, receive highly individualized personal counseling, learn about the factors for achieving success in a job, and obtain a subsidized work experience in order to put into practice what they have learned. A full-time job placement service for those not returning to the regular school program is also available to Title I funded centers. This program is now in operation in 16 high schools in the city of Detroit. The purpose of the "Manual of Procedure and Curriculum Guide" is to serve the Job Upgrading teacher-coordinator in the performance of his responsibilities as well as to provide administrators and others with information and understanding of the job. There are three main types of individuals in the program at any one time: (1) those who may be employed without a supervised work experience—these individuals may need only the counseling and help offered in morning training sessions; (2) those who need a supervised work experience—these individuals receive the same type of training as those in the first group plus a supervised work experience; and (3) those who may return to full-time school—these individuals usually attend classes in the regular high school in addition to the training provided for the above two types. (Author/JM)

ED075665 VT020040

EVALUATIVE REPORT ON PHASE II OF THE SECONDARY SCHOOLS PROJECT FOR AN INTRODUCTION TO THE ALLIED HEALTH PROFESSIONS.

Fielstra, Clarence; Chrispin, Barbara Rosenquist

California Univ., Los Angeles. Div. of Vocational Education.

Spons Agency - California State Dept. of Education, Sacramento. Bureau of Industrial Education; Office of Education (DHEW), Washington, D.C. Div. of Comprehensive and Vocational Education Research.

Pub Date Sep 72 Note-100p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Clinical Experience/*Demonstration Programs/*Dropout Prevention/*Health Occupations Education/Hospitals/Occupational Clusters/Pilot Projects/*Program Evaluation/ Secondary Grades/Vocational Counseling/*Work Experience Programs

Identifiers - California

The most difficult problem to be solved by this demonstration project was the high dropout rate in the target schools. More than half of the students routinely dropped out in the tenth grade, leading to the decision to start the program at that level in an effort to hold potential dropouts by stimulating their interest in health-care occupations. The key to the demonstrated success of this effort was getting the students into hospitals the first week of school for orientation to the institutions, gradually working into "real life" task performance in the hospital environment. Academic credit was given by the school for the work experience, and as an incentive to participate a stipend of fifteen dollars a week was paid from project funds to each student involved in the work experience phase of the program. As the program starts its third year, most of the students have been placed in part-time hospital jobs, where their training will continue. In every instance they will leave high school with salable skills qualifying them for at least an entry level hospital job or for college credit for work already accomplished. Reactions to and ratings of the program by the hospitals, the students, their parents, and the project director were all generally quite favorable. Recommendations for improvements are included in the report. A related document is available as ED 064 474. (MF)

ED072186 VT018415

PRIVATE AND PUBLIC MANPOWER POLICIES TO STIMULATE PRODUCTIVITY.

Ginzberg, Eli; et al.

National Commission on Productivity, Washington, D.C.

Pub Date Jun 71 Note-19p.

Available from - Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (ST 4000-00281; $0.30)

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Economic Factors/Economic Progress/Laborers/Labor Legislation/Manpower Development/Manpower Needs/*Manpower Utilization/*Personnel Policy/*Policy Formation/ *Productivity/*Public Policy

Identifiers - *Manpower Policies

Realizing the relationship of productivity to technological, organizational and manpower variables, and the need to improve and increase production gains, this document examines existing public and private entrepreneurial and industrial relations structures in an effort to ascertain manpower policy measures which if strengthened or introduced might facilitate production gains. Investigated and included in the content are such topics as: (1) The Nature of Change, (2) Historical Perspectives, (3) Private Arrangements, (4) Public Policies, and (5) New Directions. Findings and implications include: (1) A recognition by the Federal Government that the sine qua non for a conducive environment for stimulating productivity changes is a high level of continuing employment for the economy, and (2) There is little prospect for success on the part of either private or public manpower policy directed to facilitating the adjustment of workers affected by productivity changes except against a background of a high employment economy. (SN)

ED069911 VT017744

A STUDY OF THE EFFECTIVENESS OF SELECTED OUT-OF-SCHOOL NEIGHBORHOOD YOUTH CORPS PROGRAMS (A STUDY OF SELECTED NYC-1 PROJECTS).

George Washington Univ., Washington, D.C. Social Research Group.

Spons Agency - Manpower Administration (DOL), Washington, D.C.

Pub Date Apr 71 Note-604p.

EDRS Price MF-$0.65 HC-$23.03

Descriptors - Culturally Disadvantaged/Disadvantaged Youth/Employment Opportunities/*Employment Programs/Job Development/Job Placement/Job Skills/*Job Training/*Manpower Development/*Out-of-School Youth/Program Effectiveness/*Program Evaluation/Work Attitudes

Identifiers - *Neighborhood Youth Corps/NYC

This paper reports the results of a Neighborhood Youth Corps (NYC) prospective study, which are based on program-sourced information and second-round follow-up interviews with study subjects. The primary hypothesis that the NYC programs studied had helped enrollees achieve satisfactory adjustment to life and to the world of work was not confirmed, and an early conclusion that the NYC seemed to be most effective with Negro women was not supported by later data. Although there was no clear evidence that the NYC effectively enhanced the employability of the average enrollee, there was evidence that some program components were having a significant effect. Formal skill training, work sites with training and employment opportunities, job development, and job placement assistance appeared to be associated with increased post-NYC employment. Some other major findings were: (1) The NYC is reaching seriously disadvantaged youth with major employability problems, (2) Enrollees, on the whole, gave a good report of the usefulness of the NYC program and the helpfulness of work supervisors and counselors, and (3) The attitudes of enrollees are associated with their employability. These and other findings and implications are provided in this report. (SB)

ED068665 VT017091

EVALUATION: COORDINATED VOCATIONAL ACADEMIC EDUCATION (1969-1970 AND 1970-1971).

Williams, Revonda

Georgia Univ., Athens. Div. of Vocational Education.

Pub Date 71 Note-48p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Academic Education/*Cooperative Programs/*Disadvantaged Youth/*Dropout Prevention/Pilot Projects/*Program Coordination/*Program Evaluation/Student Evaluation/Student Improvement/Vocational Education

Identifiers - *Georgia

This paper evaluates the progress of the Coordinated Vocational Academic Education (CVAE) Program for disadvantaged students in Georgia for the school year 1970-71. Evaluation was based on changes in grades, attendance, and attitudes of students as compared with the previous school year when the new coordinated program was not in effect. The CVAE program grew out of two previous vocational programs, one a state training plan for disadvantaged students and the other developed in Forsyth County to combat their high dropout rate, negative student attitudes, and student frustrations and lack of basic skills. These two plans were evaluated and their most advantageous aspects combined into one program, CVAE, initiated throughout the state in the 1970-71

school year. This combined program was designed to help reduce the high dropout rate in Georgia by offering the students realistic academic and vocational instruction with work experience and individual attention. Data were collected through visits with school coordinators and random sampling of students. Conclusions from the survey data indicated that the new program appeared to be accomplishing its objectives and that its real potential was encouraging. Additional program studies and expansion of programs were recommended. (MF)

ED068092 JC720245

COMMUNITY COLLEGE VOCATIONAL COOPERATIVE EDUCATION: EXEMPLARY PROJECT IN VOCATIONAL EDUCATION CONDUCTED UNDER PART D OF PUBLIC LAW 90-576. SECOND ANNUAL REPORT.

Coast Community Coll. District, Costa Mesa, Calif.; San Mateo Junior Coll. District, Calif.

Spons Agency - Bureau of Adult, Vocational, and Technical Education (DHEW/OE), Washington, D.C.

Bureau No.-Proj-0-361-0069

Contract-OEC-0-71-0527(361)

Pub Date 1 Nov 72 Note-49p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Consortia/*Cooperative Education/*Junior Colleges/Program Administration/Program Effectiveness/*Program Evaluation/*Vocational Education/*Work Study Programs

Identifiers - *California

This is the second annual report concerning a multiple-option design for a cooperative education program used by a consortium of five California community colleges. (For the first annual report, see ED 058 880.) The effectiveness of the program is assessed by analyzing 15 areas such as retention, income, employer attitudes, cost effectiveness, and career training options. Innovative aspects of this cooperative education program include: (1) the use of business, industry and civic agencies within the community as experience laboratories; (2) the use of performance objectives, permitting clearer understanding of cooperative education; (3) an effective method of providing educational assistance for veterans; (4) enabling handicapped students to go beyond the traditional vocational confinement; (5) the use of computers to simplify the process of enrolling, follow-up, evaluation, and articulation; (6) presenting new employment opportunities for women; (7) the use of evaluations by students, supervisors, and employers to measure progress and give direction for the future; (8) the development of career education by combining the community college program with academic and vocational instruction in other educational programs; and (9) the enhancement of academic and skill development in law enforcement programs. (RN)

ED068088 JC720241

COOPERATIVE EDUCATION AT LAGUARDIA COMMUNITY COLLEGE: AN ASSESSMENT AND DESCRIPTION OF THE INITIATION OF AN INNOVATIVE CURRICULUM. FINAL REPORT.

Soper Associates, Berne, N.Y.

Spons Agency - New York State Education Dept., Albany. Bureau of Occupational Education Research.

Pub Date Aug 72 Note-83p.
EDRS Price MF-$0.65 HC-$3.29
Descriptors - *Cooperative Education/Curriculum Evaluation/Curriculum Planning/Educational Innovation/Internship Programs/*Junior Colleges/*Program Evaluation/*Work Experience Programs/ *Work Study Programs
Identifiers - *New York

LaGuardia College (New York) is the only community college in the United States requiring its entire student body to participate in a work-experience program regardless of curriculum choice. This study, conducted by a team of selected consultants, is an assessment of the program based on onsite visits, interviews, and an array of reports and publications. Areas of assessment were: (1) the legal framework, administrative structure and facilities; (2) the college curriculum; (3) the recruitment and enrollment program; (4) student services; (5) the college's self-evaluation program; and (6) the degree of the college's success. Some conclusions were: (1) the curriculum, using an interdisciplinary approach, individualized instruction, and a work internship program, provides a relevant experience for the student; (2) team counseling has proved to be effective and should be further developed to attain its full potential; (3) there is a pronounced need for additional funding sources to aid the financially pressed student; (4) recruitment methods need to be more comprehensive; (5) the college should continue to seek ways to evaluate the degree to which it is meeting its goals and objectives; and (6) the program merits close study by education authorities in other major metropolitan areas. (RN)

ED068559 VT016040
SCHOOL, COMMUNITY AND YOUTH. STATEWIDE EVALUATION OF PART G PROGRAMS IN COOPERATIVE VOCATIONAL EDUCATION IN THE STATE OF ILLINOIS/1971-1972.
Southern Illinois Univ., Carbondale.
Spons Agency - Illinois State Board of Vocational Education and Rehabilitation, Springfield. Vocational and Technical Education Div.
Pub Date 31 May 72 Note-108p.
EDRS Price MF-$0.65 HC-$6.58
Descriptors - *Cooperative Education/Dropout Characteristics/*Dropout Prevention/Dropout Research/*Dropouts/Family Background/Instructor Coordinators/Program Costs/*Program Evaluation/Student Characteristics/Student Needs/Tables (Data)/*Vocational Education
Identifiers - Career Exploration/Illinois/Vocational Education Acts

Two types of educational programs were designed to reach the potential dropout of 14-15 years of age and the early school leaver. The first program, known as the Work Experience and Career Exploration Program (WECEP), was developed to expose potential dropouts to the world of work and to impress upon them the importance of a high school education. The second program, the Early School Leaver Program (ESL), provides an opportunity to upgrade job skills by exploring the world of work and by acquiring greater academic skills. This document represents an evaluation of these programs and includes research data on: (1) student characteristics, (2) the health study, (3) sleep and nutrition patterns, (4) student gains, (5) program characteristics, (6) teacher-coordinator profile, (7) program administration, (8) costs allowed to employers and students, and (9) applications of a cost-benefit model to programs in cooperative vocational education. (JS)

ED066153 JC720194

AN EVALUATION OF THE SUMMER READINESS PROGRAM: NYC GOES TO COLLEGE, SUMMER 1972.

MacMillan, Thomas F.; et al.

Santa Barbara City Coll., Calif. Office of Research and Development.

Report No.-ROM-14-72

Pub Date 1 Sep 72 Note-16p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - *Disadvantaged Youth/Employment Opportunities/*Junior Colleges/*Program Evaluation/School Orientation/*Summer Programs/Summer Schools/*Work Study Programs/Youth Programs

Identifiers - *California

The Summer Readiness Program, sponsored by Santa Barbara City College (California) and Neighborhood Youth Corps (NYC) is an orientation program for disadvantaged students. The 65 students enrolled during summer 1972 were given tutorial assistance and group-counseling and were placed in part-time jobs. In addition to making recommendations, one purpose of this study was to provide data concerning student demographic characteristics, academic aptitude, persistence, and performance. Some findings were that: (1) 58 percent of the students were Chicano, 25 percent were Black, and 17 percent were Caucasian; (2) family income was less than $5,000 for 78 percent of the student families; (3) average family size was 5.5; (4) academic aptitude as reflected by SCAT total score approached the fortieth percentile; (5) 91 percent of the enrolled students completed the summer session; and (6) all of the NYC students plan to continue their education in the fall. Opinions were solicited from the NYC campus staff and students as part of the program evaluation and the following recommendations were made: (1) early and regular contact should be maintained between college and NYC staff; (2) all pre-counseling should occur before registration; (3) NYC students should meet as a group at least bi-weekly; (4) a college counselor should be assigned to the program; (5) students should be assigned jobs related to their career objectives; and (6) an orientation should be provided for summer faculty concerning the nature of the NYC program. (RN)

ED063503 VT015710

COOPERATIVE VOCATIONAL EDUCATION COORDINATOR'S HANDBOOK. VOLUME II, OPERATION AND ADMINISTRATION.

Allen, Thomas P., Jr.

Marshall Univ., Huntington, W. Va. Dept. of Vocational-Technical Education.

Pub Date 72 Note-72p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Adult Education/Advisory Committees/Check Lists/*Cooperative Education/Legislation/*Program Administration/*Program Coordination/*Program Evaluation/*Program Guides/Program Planning/Research Needs/Secondary Education/Youth Clubs

Identifiers - Beginning Competence

Developed as the second part of a 2-volume program guide, this document should be of particular interest to coordinators and administrators of cooperative vocational education programs on both the secondary and post-secondary levels. Major sections of guide are: (1) Planning Activities for Cooperative Vocational Education Programs, (2) Advisory Committee, (3) Youth Organizations,

(4) Existing Vocational Youth Organizations, (5) Adult Education, (6) Federal and State Laws, and (7) Providing for Research in Cooperative Vocational Education. Checklists for the evaluation of cooperative programs and related sections of the West Virginia state plan are also included. Volume I of this program guide is available as VT 015 711. (JS)

ED062513 VT014803

REVIEW AND ANALYSIS OF INSTRUCTIONAL MATERIALS FOR COOPERATIVE VOCATIONAL EDUCATION.

Wallace, Harold R.

Ohio State Univ., Columbus. The Center for Vocational Education.

Spons Agency - Office of Education (DHEW), Washington, D.C.

Report No.-Inf-Ser-60

Pub Date 72 Note-30p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Bibliographies/*Cooperative Education/*Curriculum Evaluation/*Instructional Materials/Job Training/Learning/*Literature Reviews/Relevance (Education)/*Research Reviews (Publications)/Student Participation/Technical Education/Validity/*Vocational Education

Three learning situations found in the cooperative program, namely vocational or technical course work, training stations, and the related class, are described and pertinent curriculum materials are reviewed. In addition to content, the reviewer examines quality and usefulness, validity, enrichment materials and instructional aids, and student involvement and participation, according to criteria which he sets forth in the document. Seven documents designed for a variety of occupational areas, five documents designed for use in a single occupational or vocational field, and 12 periodicals are reviewed. (GEB)

ED060182 VT014465

A STUDY OF THE STATUS AND EFFECTIVENESS OF COOPERATIVE OFFICE EDUCATION IN NEW JERSEY, 1968-69.

Kingston, Carmela C.

Spons Agency - New Jersey State Dept. of Education, Trenton. Occupational Research and Development Branch.

Report No.-Monog-8

Pub Date 70 Note-39p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - *Business Education/*Cooperative Education/Doctoral Theses/Employer Attitudes/Job Placement/Office Occupations Education/*Program Evaluation/*Project Training Methods/Student Characteristics/*Vocational Follow-up

Identifiers - New Jersey

This monograph summarizes a doctoral study on the effectiveness and status of New Jersey's cooperative business education programs. The general hypothesis of the study was that compared to non-cooperative office education students, cooperative students will: (1) be employed sooner, (2) be employed in more responsible positions, (3) receive higher earnings, (4) be more satisfied with their jobs, and (5) be rated more highly by their job supervisors. Among the conclusions of

the study were: (1) The cooperative office education programs benefited those students who wanted to begin working immediately after high school, (2) Cooperative office education did not appear to have an effect on the beginning salary, (3) Cooperative office education did appear to have an effect on salary increases received by beginning workers, (4) A high degree of job satisfaction was indicated by both the cooperative and non-cooperative students, (5) Employers were better satisfied with those beginning office workers who were cooperative office education graduates, and (6) Cooperative office education did not appear to have a significant effect on the quantity or quality of the work performed by the beginning office workers. Numerous recommendations are also included. (Author/JS)

ED060139 UD012115

EVALUATION OF THE JUNIOR HIGH WORK TRAINING PROGRAM, 1970-71.

Woolfolk, E. Mansfield

Detroit Public Schools, Mich. Dept. of Research and Development.

Pub Date Nov 71 Note-23p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Attendance Records/Compensatory Education Programs/Disadvantaged Youth/Dropout Identification/*Dropout Prevention/Inner City/*Program Evaluation/Secondary School Students/Statistical Analysis/Task Performance/Work Attitudes/*Work Experience Programs

Identifiers - *Elementary Secondary Education Act Title I/ESEA Title I/Michigan

Funded under ESEA Title I, this program was designed to provide income and work experience for disadvantaged junior high school youths age 14 and above; and, to provide incentives which would motivate youths to continue their education through high school. The wages earned were intended to enable the student to provide for some of his personal needs. Additionally, it was expected that the student would view school more favorably. The specific objectives for participants were as follows: (1) to remain in school at least one year past their 16th birthday; (2) to improve in school attendance and punctuality; and (3) to show growth in the ability to perform on the job along with good work habits. The evaluation procedure consisted of obtaining: (a) follow-up data on former participants concerning how many remained in school for at least one year beyond their 16th birthday; (b) absence and tardiness records of selected samples of participants and non-participants; and (c) ratings of trainees by work sponsors early in the student's work experience on several job performance characteristics. (Author/JM)

ED056067 TM000865

DEVELOPMENT OF GUIDANCE MEASURES FOR YOUTH-WORK TRAINING PROGRAM ENROLLEES PHASE I: MEASUREMENT OF PROGRAM OBJECTIVES AND THE DEVELOPMENT OF CRITERIA. FINAL REPORT.

Freeberg, Norman E.; Reilly, Richard R.

Educational Testing Service, Princeton, N.J.

Spons Agency - Manpower Administration (DOL), Washington, D.C.

Report No.-PR-71-13

Pub Date Jul 71 Note-152p.

EDRS Price MF-$0.65 HC-$6.58

Descriptors - Cluster Analysis/Disadvantaged Youth/Employee Attitudes/*Evaluation Criteria/Factor Analysis/Job Satisfaction/*Job Training/*Program Evaluation/Questionnaires/Success

Factors/Task Performance/Vocational Adjustment/*Work Experience Programs/*Youth Employment

Identifiers - *Neighborhood Youth Corps/Program Objectives

Rationally defined outcome variables, for use in evaluating youth-work training programs, were incorporated in questionnaires administered to present and former Neighborhood Youth Corps enrollees and analyzed to determine their suitability as criterion measures. Using a factor analytic technique, empirically defined clusters were obtained for immediately available outcomes and longer-term outcomes. The most logical groups of criteria were found for those former enrollees who had full-time employment experience. Relatively clear patterns of job-oriented capability and success were dominant as were two separate factors bearing on personal adjustment to the job and to the community. Some descriptive highlights concerning the vocational behaviors of former trainees are presented and future research needs for better definition and understanding of program objectives are discussed. For the six rating instruments used in the study, see TM 000 866-871. (Author/AG)

ED055208 VT013924

A COMPARATIVE ANALYSIS OF SELECTED STUDENT CHARACTERISTICS AND VOCATIONAL COOPERATIVE PROGRAMS.

Ullery, Jesse William

Pub Date Jan 71 Note-188p.; Ed. D. Dissertation, Illinois University

Available from - University Microfilms, Inc., P. O. Box 1764, Ann Arbor, Michigan 48106 (MF $4.00; Xerography $10.00)

Document Not Available from EDRS.

Descriptors - Admission Criteria/Comparative Analysis/Cooperative Education/*Cooperative Programs/Doctoral Theses/Program Administration/Program Effectiveness/*Program Evaluation/*Student Characteristics/*Student Needs/*Vocational Education

This study focused on aspects of a problem defined through statements of both general and particular objectives. Included as general objectives were: (1) the development of a method for identifying and describing groups of students excluded from Cooperative Work Education (CWE) programs, and (2) the development of comparative analysis of students admitted to and students excluded from CWE programs. Particular objectives were: (1) to assess the student selection criteria and practices, and overall operations, of a local school system's CWE program, and (2) to determine the extent to which these criteria, practices, and operations were responsive to school system policy, and to national goals, priorities, and problems. Descriptive in nature, the study used non-parametric techniques since assumptions of normal distribution were in question. A major conclusion of the study is that the characteristics of students excluded overtly or covertly from the school system's CWE programs strongly suggest that many students were denied admission to CWE on the basis of such factors as (1) socioeconomic class, (2) race, (3) age, (4) sex, (5) dropout proneness, (6) low school achievement, (7) absenteeism, and (8) similar or related factors. It is also noted that students excluded from CWE programs are those who need the programs the most. (Author/JS)

ED054303 VT010788

HOUSTON'S OUT-OF-SCHOOL NEIGHBORHOOD YOUTH CORPS: A COMPARATIVE OBSERVATIONAL STUDY OF THE NYC'S IMPACT ON THE WORK ATTITUDES AND JOB FUTURES OF POVERTY YOUTHS.

Harwood, Edwin; Olasov, Robert
Rice Univ., Houston, Tex. Dept. of Anthropology and Sociology.
Spons Agency - Manpower Administration (DOL), Washington, D.C. Office of Manpower Research.
Pub Date Oct 68 Note-299p.
Available from - National Technical Information Service, Springfield, Va. 22151 (PB-184978, MF $.95, see catalog for hard copy price)
Document Not Available from EDRS.
Descriptors - Disadvantaged Youth/Federal Programs/*Manpower Development/Manpower Utilization/*Out of School Youth/*Program Evaluation/*Program Improvement/Research Needs
Identifiers - *Neighborhood Youth Corps

To evaluate the effect of three Houston Neighborhood Youth Corps (NYC) out-of-school programs on work attitudes and job futures of poverty youth as well as to provide recommendations for program improvement, statistical data were gathered from NYC sponsors' reports and from the trainees' personal folders. The accuracy of the data is limited because it was not always known how the sponsors compiled the data, and there were some informational gaps in the trainees' folders. Some major findings were: (1) Few males are in the program because they can earn more money in unskilled and semi-skilled jobs, (2) More females are in the programs because they cannot compete as well for the better paying semi-skilled jobs, (3) Remedial education has been a failure, (4) The agencies that need trainee labor the most are often the least able to hire and pay the lowest wages, and (5) The sponsor faces a serious dilemma in the case of those girls who are of low-level intelligence, unmotivated, or exceptionally deficient in education. Recommendations were made for work stations, counselor caseloads, trainee enrollment, counseling techniques, restrictions on male employment, training courses for females, and financial rewards and bonuses. (SB)

ED053308 VT013434
A JOB CORPS STUDY OF RELATIVE COST BENEFITS, VOLUME I AND II.
Software Systems, Inc., Washington, D.C.
Spons Agency - Office of Economic Opportunity, Washington, D.C. Job Corps.
Pub Date Apr 69 Note-138p.
EDRS Price MF-$0.65 HC-$6.58
Descriptors - *Adult Vocational Education/*Cost Effectiveness/*Disadvantaged Youth/*Federal Programs/Mathematical Models/Poverty Programs/*Program Evaluation/Research Methodology
Identifiers - *Job Corps

This study was undertaken to relate Job Corps training outcomes to the costs of training, in terms of human talent, time, and material resources. Training outcomes or benefits were classified according to Job Corps objectives, then compared to total costs incurred by both training center and enrollee. Empirical validation and other evaluation of the procedure proved it to be sound and applicable in a comparison of manpower training programs. The results reversed several conclusions of earlier studies which had considered outcomes only. When costs are included in the analysis, it is no longer true that young or rural corpsmen perform poorly. When heavily oriented placement scales are used as criteria, the superior performance records of black corpsmen is reversed. A detailed presentation of the model is included, along with tables displaying the full results of the analysis. (BH)

ED053302 VT013294

A COST-EFFECTIVENESS STUDY OF THE IN-SCHOOL AND SUMMER NEIGHBORHOOD YOUTH CORPS.

Somers, Gerald O.; Stromsdorfer, Ernst W.

Wisconsin Univ., Madison.

Pub Date Jul 70 Note-450p.

EDRS Price MF-$0.65 HC-$16.45

Descriptors - Comparative Analysis/*Cost Effectiveness/Educational Improvement/Interviews/*Manpower Development/*National Surveys/*Program Evaluation/Questionnaires/Statistical Analysis/*Youth Programs

Identifiers - *Neighborhood Youth Corps/NYC

This nationwide study to determine the cost-effectiveness of the Neighborhood Youth Corps Program (NYC) is based on participants from projects in operation during fiscal year 1965-66 and 1966-67. Out of the original 1,120 projects 60 were randomly selected, 20 from the three regions—north, south, and west. The sample size of the participants was 780 for the estimation of educational benefits and 676 for economic benefits. An interview survey technique was used to collect data, as well as a mail questionnaire and telephone contacts. Specific conclusions were: (1) The program had no significant effect on the number of high school grades completed, (2) Participants of the program who finished high school were more likely to continue their education after graduation, (3) The participants' earnings were enhanced more by encouragement to participate in the labor force than by increased skills and reduced unemployment, and (4) Negroes gained more from the program than any other ethnic group. (GEB)

ED050226 VT006122

A COMPARISON OF TWO METHODS OF PREPARING YOUTH FOR EMPLOYMENT: COOPERATIVE OCCUPATIONAL EDUCATION VERSUS THE PREPARATORY VOCATIONAL-TECHNICAL SCHOOL.

Sanders, Lester H.

Missouri State Dept. of Education, Jefferson City.; Missouri Univ., Columbia. Coll. of Education.

Pub Date 67 Note-26p.; Summary of Ed.D. dissertation, Missouri Univ., 1967

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Cocurricular Activities/*Cooperative Education/Cost Effectiveness/*Curriculum Evaluation/Doctoral Theses/Employer Attitudes/Follow-up Studies/Job Placement/Job Skills/Parent Attitudes/*Project Training Methods/Student Attitudes/*Trade and Industrial Education/Wages/*Work Experience

Identifiers - Missouri/Springfield

To analyze and compare the cooperative occupational education and vocational-technical school programs and graduates in the Springfield, Missouri, public schools, information forms were sent to: (1) 268 graduates of the cooperative occupational education programs and 417 graduates of the vocational-technical school for the years 1961-1965, (2) their parents, and (3) present and past employers. Some conclusions were: (1) Vocational-technical programs seemed to have greater impact in maintaining student interest and improving attitudes towards school, (2) Cooperative education graduates emphasized the development of desirable personal-social characteristics and vocational-technical graduates emphasized job skills and related knowledge, (3) Transition from school to full-time employment is made more quickly and easily through cooperative education

programs, (4) A majority of vocational-technical graduates took advantage of unsupervised work experience programs while in high school, (5) After a period of adjustment, the vocational-technical graduates tended to return to the occupation for which they were trained in greater numbers, and (6) Cooperative education graduates tended to demonstrate more desirable personality traits, work habits, and a higher degree of occupational competency. (DM)

ED047095 VT012269

AN EVALUATION OF 1970 SUMMER WORK-STUDY PROGRAMS.

Ebey, George W.; et al.

URS Research Co., San Mateo, Calif.

Spons Agency - California State Dept. of Education, Sacramento.

Pub Date Nov 70 Note-68p.

Available from - URS Research Company, 155 Bovet Road, San Mateo, California 94402

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Minority Groups/*Program Evaluation/*Seasonal Employment/*Secondary School Students/*State Programs/*Work Study Programs/Youth Employment

Identifiers - *California

This summer work-study program enrolled 1,163, high school students from eight urban school districts. In order to evaluate the program, 240 interviews were held with students, teachers, teacher aides, work supervisors, project coordinators, and district general administators. Reactions by all groups were enthusiastic, with the major complaints involving the need for expansion of the program. There was general agreement that this program was better than either of the two previous programs, despite a drop in enrollment. Recommendations were made for: (1) providing ongoing programs, (2) early funding to assure effective planning, (3) relaxing age requirements, (4) extending programs to reach all high school students, (5) improving communications between districts, (6) extending the work portion of the program to commercial organizations, and (7) holding a conference to plan a continuing year-round program. (BH)

ED043770 VT011859

AN INVESTIGATION OF FACTORS ESSENTIAL TO SELECTING AND PREPARING ON-THE-JOB TRAINERS FOR A POST-SECONDARY COOPERATIVE VOCATIONAL-TECHNICAL EDUCATION PROGRAM.

Wilson, Roger John

Pub Date 70 Note-153p.

Available from - University Microfilms, Inc., 300 North Zeeb Road, Ann Arbor, Michigan 48106

Document Not Available from EDRS.

Descriptors - *Cooperative Education/Post-Secondary Education/*Program Evaluation/Program Improvement/*Supervisory Training/*Surveys/Technical Education/*Trainers/*Vocational Education/Work Experience

By passing the 1968 Vocational Education Act with its special provisions for cooperative education, Congress has highlighted the value and rapid growth of on-the-job programs. However, with this increased emphasis on cooperative education comes the need for investigating the present practices of selecting and preparing the on-the-job trainer assigned to a student-learner. For the

most part data for the study was gathered by reviewing related literature and visiting a sample of nine 2-year institutions to interview teacher-coordinators. An analysis of the interview findings led to the conclusion that the selection of the on-the-job trainer was under the control of the teacher-coordinator through his approval or disapproval of the cooperating employer. It was also concluded that the on-the-job trainer was given little if any planned preparation before he undertook his teaching task. A significant recommendation of this study is that teacher-coordinators must take advantage of their responsibility and position to control the selection and preparation of the on-the-job trainers. This Ph.D. dissertation was submitted to The Ohio State University. (Author/JS)

ED041958 UD007748

AN EVALUATION OF THE MUNICIPAL COOPERATIVE EDUCATION PROGRAM OF THE HIGH SCHOOLS OF THE CITY OF NEW YORK.

Wohl, Seth F.

New York City Board of Education, Brooklyn, N.Y. Bureau of Educational Program Research and Statistics.

Report No.-BEPRS-P-312-PNR-167

Pub Date Jun 68 Note-138p.

EDRS Price MF-$0.65 HC-$6.58

Descriptors - Academic Performance/Administration/Administrator Attitudes/*Community Agencies (Public)/*Cooperative Education/*Cooperative Programs/Data Collection/Employer Attitudes/Follow-up Studies/High School Students/Interviews/*Program Evaluation/Questionnaires/Student Attitudes/Surveys/Teacher Attitudes/*Work Study Programs

Identifiers - New York City

This report evaluates the operation and effects of a work-study program among high school juniors and seniors following its extension to municipal agencies of the city of New York. The evaluation forms part of a five-year program, and constitutes an internal self-examination of the administrative and operational aspects of the institutions. The study examines the program's effects upon students' goals, and its service to the community. Two methods were utilized for coordinating school and work experiences—full-time employment of students on an alternate week or two-week basis, and a daily work-study plan, where students attend school each morning and are employed in the afternoon. Five major schools visited were selected for control studies. Descriptive analyses were made of the administration of the various aspects and departments of the program. Through interview information, the attitudes of supervisory personnel in city departments to the program were assessed; in 1964, this was effected by means of a questionnaire student attitudes were evaluated through a questionnaire relating to work experiences and school learning. In general, the school performance of the project students was found to be slightly superior to the comparable performance of their control group peers. Principals were found to be generally favorable toward the program. Student attitudes toward the program were also found to be positive. (RJ)

ED041096 24 UD010466

A STUDY OF SCHOOL ACTIVITIES INTENDED TO EFFECT RACIAL, ECONOMIC, OR SOCIAL BALANCE. FINAL REPORT.

Ackerman, Donald

State Univ. of New York, Stony Brook.
Spons Agency - Office of Education (DHEW), Washington, D.C. Bureau of Research.
Bureau No.-BR-8-B-085
Grant-OEG-0-8-080085-3729(010)
Pub Date 18 Aug 69 Note-39p.
EDRS Price MF-$0.65 HC-$3.29

Descriptors - Academic Achievement/Achievement Gains/Community Attitudes/*Cooperative Programs/*Disadvantaged Youth/Economic Factors/*Equal Education/Financial Needs/Parent Attitudes/*Program Evaluation/Racial Balance/*School Activities/Social Change/Teacher Education/Urban Education

The focus of this study is on the problems and prospects of providing quality education to children of the disadvantaged inner city school districts, particularly in the face of continued movement of the more affluent families to suburban areas. Based on examination of the literature on the many facets of the urban-suburban education problem, on reports and proposals for ongoing cooperative urban-suburban programs, and on visits to programs or program officials, the following were the findings that emerged: (1) academic achievement of disadvantaged students exposed to cooperative programs has been significantly high; (2) trouble spots anticipated in these programs (such as behavior problems) did not materialize; and (3) general opposition to these programs by parents and taxpayers decreased with time. Among the recommendations suggested are: (1) development of a model to bring such cooperative programs to the attention of all citizens; (2) expansion of teacher training programs by schools of education to include appreciation of urban-suburban problems; and (3) establishment of a national committee on goals for urban-suburban education in order to take care of research on and the funding of such programs. (RJ)

ED036775 AC006605

THE EVALUATION OF GOVERNMENT PROGRAMS: THE CASE OF NEW HAVEN'S MANPOWER TRAINING ACTIVITIES.

Goldfarb, Robert S.
Yale Univ., New Haven, Conn.
Pub Date 68 Note-260p.; Ph.D. Thesis
Available from - Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151 (PB-182-173, MF $.65, HC $3.00)
Document Not Available from EDRS.

Descriptors - *Conventional Instruction/Cost Effectiveness/Doctoral Theses/Employer Attitudes/Evaluation Criteria/*Federal Programs/Interviews/Job Training/*Manpower Development/*On-the-Job Training/Participant Satisfaction/*Program Evaluation/Research Methodology/Teaching Techniques

Identifiers - Connecticut/New Haven

This thesis attempts to deal with difficult methodological problems of program evaluation; the particular programs considered are two types of manpower training programs: institutional or "classroom" training and government-subsidized on-the-job training. Characteristics of cost-benefit analysis are investigated and the method is criticized for use in analyzing manpower programs. Two data sources are used to study the production process. First, a group of trainees who underwent each type of training were interviewed. Second, employers who participated in the OJT program were interviewed, as were a group of the largest employers in the New Haven area. (Author/EB)

ED036648 08 VT010400

A PILOT PROJECT TO DEVELOP A PROGRAM OF OCCUPATIONAL TRAINING FOR SCHOOL ALIENATED YOUTH. FINAL REPORT AND RELATED MATERIALS.

Connecticut State Board of Education, Hartford. Center for Vocational Arts.

Spons Agency - Office of Education (DHEW), Washington, D.C. Bureau of Research.

Bureau No.-BR-5-0005

Contract-OEC-5-85-055

Pub Date Dec 69 Note-197p.

EDRS Price MF-$0.65 HC-$6.58

Descriptors - *Evaluation/Multimedia Instruction/*Pilot Projects/*Student Alienation/Tables (Data)/*Vocational Education/*Work Experience Programs/Youth

Identifiers - Connecticut/*Norwalk

The Center for Vocational Arts provided a work-study upgraded program for male and female school-alienated youths 15-21 years of age. The basic elements of the program were individual programs, vocational training, counseling, basic academic education, and supervised work experience. For 3 hours a day the students attended classes and for the remainder they held part-time jobs. Training courses were offered in automotive, food, health, office, and manufacturing operations, retailing services, landscaping and horticulture, and maintenance and repair operations. Students could enter the program at any time during the year, and when they demonstrated sufficient competency they received a high school diploma or vocational certificate. The report on the program also included research reports, an evaluation of the program, and a guide for developing multimedia learning activity which provided such teaching aids as film-loops, tapes, slides, and artifacts. The Second Interim Report, Appendix to Second Interim Report, and the Interim Report and Statistical Evaluation are available as ED 025 641, ED 025 642, and ED 016 868 respectively. (BC)

ED035807 AC006236

MANAGEMENT'S ATTITUDES AND EVALUATIONS OF GOVERNMENT TRAINING PROGRAMS AND GOVERNMENT SUBSIDIZATION FOR INDUSTRIAL TRAINING.

Toothaker, Robert C.

Maine Univ., Orono.

Pub Date 68 Note-13p.; M.A. Thesis (abstract)

Available from - Director, Manpower Research Project, South Stevens Hall, University of Maine, Orono, Maine 04473

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Disadvantaged Groups/*Employer Attitudes/Employment Opportunities/*Evaluation/*Federal Aid/*Industrial Training/Institutes (Training Programs)/*Management/On-the-Job Training/State Aid

This research project examined management's attitudes toward government training programs and the subsidization of industrial training. Questionnaires were addressed to general managers but many responses were from personnel directors, presidents, vice presidents, and others. The basic research tool contained checklists, ranking, and open-ended questions. The sample included 476 of Maine's manufacturing firms that employ 25 or more persons. Of the 159 (33.4 percent) questionnaires returned, all but two were usable. Questionnaires came from employers with about 50 percent of the employees in the sample. The approximately 60 percent of the respondents who knew about government training programs and who were more familiar with federal than with state and local ones, obtained their information through the mass media. Government subsidy to employers

to encourage on-the-job training was preferred to institutional training by 65 percent of the employers. About 49 percent of the managers were willing to hire "disadvantaged" workers when their on-the-job training could be supported by federal funds, but only 42 percent were interested in hiring those who were institutionally trained. Thirty of the 157 responding firms reported applications for work from government trained workers, and of the 579 applicants 477 were hired. (NL)

ED029446 40 EC004014

STUDENT WORK EXPERIENCE AND TRAINING PROGRAM. FINAL REPORT.

Price, William F.

Southern Illinois Univ., Carbondale.

Spons Agency - Office of Education (DHEW), Washington, D.C.

Bureau No.-BR-8-8068

Grant-OEG-0-8-088068-4482(032)

Pub Date 68 Note-11p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Camp Counselors/Camping/Career Change/Career Choice/*Exceptional Child Services/*Mentally Handicapped/*Program Evaluation/Recreation/Student Evaluation/Student Experience/*Summer Programs/*Work Experience Programs

Identifiers - Student Work Experience and Training Program/SWEAT Program

Twenty high school and college students aged 16 to 20 were trained as summer camp counselors in a project to provide experiences leading to choosing a career with the mentally retarded. In the 11-week period, 1 week was devoted to lectures and seminars, 8 weeks to working with the retarded, and 2 weeks to working with multiple handicapped adults. A summary evaluation of each student was made from answers to a questionnaire distributed at the beginning, middle, and end of the program. Of the 20 students, six indicated they would choose special education as a career, five would not choose it, and nine would work as volunteers in local communities although they would probably not choose special education as a career. All 20 participants are described and evaluated. (SN)

ED026501 VT007221

EVALUATION OF THE IN-SCHOOL YOUTH WORK-TRAINING PROJECT FOR FOURTEEN AND FIFTEEN YEAR OLD YOUTH.

Detroit Public Schools, Mich. Dept. of Research and Development.

Pub Date Jan 68 Note-25p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Disadvantaged Youth/*Dropout Prevention/Follow-up Studies/*Junior High School Students/*Potential Dropouts/Program Development/Program Effectiveness/*Program Evaluation/*Work Experience Programs

Identifiers - Detroit Public Schools/Elementary Secondary Education Act Title 1 Program/ESEA Title 1 Program/*Project In School Youth Work Training Program

A project to provide in-school work experiences for 14 and 15 year old junior high school students was conducted for the purpose of: (1) encouraging them to remain in school after the

age of 16, (2) improving their school attendance and scholastic achievement, (3) providing opportunities for growth in the ability to work and explore aspects of the world of work, and (4) providing income, sound work habits, work training, and salable skills for pupils from low income families. Data from the fall term of 1966 on 140 pupils who had participated in the program were compared with data from the fall term of 1965. A follow-up was conducted on 42 students who had participated in the project. The chi-square test of significance showed no statistically significant changes in the frequency counts of absences or tardiness or changes in the distribution of academic grades or citizen marks. Case studies indicate that individual students did show progress in academic performance, in attitude toward school, and in social demeanors. In general, the program met only the objectives of providing earned financial assistance to needy pupils and providing pupils with supervised work experiences which will better prepare them for entry into the world of work. (MM)

ED025635 VT007343

JOB TRAINING: RESEARCH REPORT NUMBER FOUR.

American Society for Personnel Administration.; Manpower Research Council, Milwaukee, Wis.

Pub Date 67 Note-10p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Educational Problems/*Educational Supply/*Employer Attitudes/Federal Programs/*Industrial Training/Job Training/Manpower Development/National Surveys/*Program Evaluation/*Vocational Education

Identifiers - Job Corps/Manpower Development and Training Act Programs/MDTA Programs

This document contains a summary of a survey of 930 companies employing 4,375,665 persons throughout the United States. The survey specifically deals with the companies' experiences with in-plant and outside agency job training programs. Some of the findings were: (1) Respondents feel that there are numerous institutions at work in the community to provide skill training, but 60 percent feel that this training falls short of their company needs, (2) Participants expressed great willingness to serve on advisory boards, (3) About 50 percent felt their universities lack adequate vocational training facilities and recommended public high school and in-plant training as the solution, (4) Over 85 percent are in favor of development of public vocationally oriented technical colleges on a 2-year basis, (5) 17 percent have established training programs with a view to attracting minority workers and 50 percent felt their programs were successful, (6) Manpower Development Training Administration has not helped find qualified employees for 80 percent of the respondents, and (7) Only 19 percent have employed persons trained in Job Corps centers, and of that group, 60 percent regard the experience as satisfactory. (MM)

ED024012 AC003161

A FOLLOW-UP STUDY OF GRADUATES' AND EMPLOYERS' OPINIONS OF A COOPERATING TRAINING PROGRAM. RESEARCH STUDY NO. 1.

Tuttle, David Chester

Colorado State College, Greeley.

Pub Date 65 Note-110p.; Ed.D. Thesis.

Available from - University Microfilms, 300 Zeeb Rd., Ann Arbor, Michigan 48106 (Order No. 65-267, MF $3.00, Xerography $5.40).

Document Not Available from EDRS.

Descriptors - *Cooperative Education/Doctoral Theses/*Employers/Employment Patterns/Family Influence/*Follow-up Studies/*High School Graduates/Participant Satisfaction/*Program Evaluation/Program Improvement/Questionnaires/Statistical Data/Training/Vocational Counseling

Identifiers - *Des Moines/Iowa

Interviews collected information from 135 graduates of the trades and industrial cooperative education training program, and 30 employers in Des Moines, Iowa, to appraise the effectiveness of training in relation to post-high school employment. Graduates and employers commented on the value of core area training, school counseling, and different phases of the training program. It was found that the primary reasons for enrolling in the program were to gain work experience and earn extra money. Personal feeling and family influenced choice of core area. Sixty-two percent of the graduates were working at, or in, areas related to their high school training. Satisfaction was expressed with training, present job, and the school counseling and coordinating service. Employers felt training helped graduates secure employment and receive promotions. Graduates felt core area training could be improved by more production training and wider experience on shop equipment, while employers thought additional training in production work, business ethics, and employment procedures should be included in the core area training. (Author/PT)

ED022911 08 VT005939

THE DEVELOPMENT AND IMPROVEMENT OF DIRECTED WORK-EXPERIENCE PROGRAMS IN EXPANDED VOCATIONAL EDUCATION OFFERINGS IN AGRICULTURE AT THE SECONDARY SCHOOL LEVEL. FINAL REPORT.

Cushman, Harold R.; et al.

State Univ. of New York, Ithaca. Coll. of Agriculture at Cornell.

Spons Agency - Office of Education (DHEW), Washington, D.C.

Bureau No.-BR-5-0161

Grant-OEG-1-6-000369-0655

Pub Date Jun 68 Note-158p.

EDRS Price MF-$0.65 HC-$6.58

Descriptors - Academic Achievement/Agricultural Engineering/Comparative Analysis/Control Groups/*Cooperative Education/*Curriculum Evaluation/Employer Attitudes/Employment Experience/Experimental Groups/Grade 12/High School Students/Measurement Instruments/*Off Farm Agricultural Occupations/Ornamental Horticulture/*Program Development/Program Guides/Questionnaires/Student Attitudes/Teacher Attitudes/*Vocational Agriculture/Work Attitudes

The project objectives were to (1) develop empirically tested guidelines and procedures for initiating, developing, and operating cooperative education programs for secondary students in off-farm agricultural occupations, (2) evaluate the effectiveness of cooperative work experience, and (3) determine the effect of the extent of work experience on educational and occupational criteria. The sample included 35 students in agricultural mechanics and 68 students in ornamental horticulture from 16 high schools. Students from 10 high schools were used as a comparison group. Teachers, students, and employers endorsed the effectiveness of the guidelines and procedures used as the structural model. When compared with students enrolled in similar programs without work experience student engaged in directed work experience rated higher in technical knowledge, entry into curriculum-related employment following graduation, and entry into curriculum-related programs of advanced training. No differences were observed in the criterion performance of students with

high and low amounts of occupational experience hours. Lists of contributing personnel, instruments used, and scaling models are included in the appendix. Other documents of this series are available as VT 005 938, VT 006 447, and ED 019 494. (DM)

ED022854 VT003808

A NOTE ON: APPRENTICESHIP AND ECONOMIC CHANGE.

Manpower Administration (DOL), Washington, D.C. Bureau of Apprenticeship and Training.

Report No.-TR-3

Pub Date 64 Note-28p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - *Apprenticeships/Employment Trends/*National Programs/*Program Evaluation/Trade and Industrial Education/Unemployment

The apprenticeship system in the United States is a method of training for a vocation or skilled trade within the framework of a relatively free labor market. It is a system which furnishes training through employment and one which is affected by the employment level of a given period. This is particularly important as the apprenticeship typically lasts 4 years, and the apprentice need at the termination of the training period may not be the apprentice intake based on the employment level 4 years earlier. The declining trend in apprenticeship since World War II cannot be attributed to any single cause, but the increased number of persons who continue their formal education seems to be the major one. Major factors which affect of apprentices are: (1) irregularity of employment rate, (2) the completion rate, (3) unemployment, (4) college and apprentice enrollment, and (5) the ratio between craftsmen and professional-technical personnel. Statistical analysis indicates no significant relationship between the number of apprentices and the number of journeymen. Although apprentice numbers appear to have been small due to employer reluctance to train skilled workers rather than to union policy, relatively little consideration has been given to the system itself, the factors affecting the employer's decision to hire apprentices, nor the factors affecting the apprentice's decision to enter or complete such a training program. (EM)

ED020407 VT005173

A RETROSPECTIVE STUDY OF THE EFFECTIVENESS OF OUT-OF-SCHOOL NEIGHBORHOOD YOUTH CORPS PROGRAMS IN FOUR URBAN SITES.

Walther, Regis H.; Magnusson, Margaret L.

George Washington Univ., Washington, D.C. Social Research Group.

Spons Agency - District of Columbia. Manpower Administration (DOL), Washington, D.C. Office of Manpower Research.

Pub Date Nov 67 Note-157p.

EDRS Price MF-$0.65 HC-$6.58

Descriptors - *Adjustment (to Environment)/Comparative Analysis/Control Groups/*Disadvantaged Youth/Experimental Groups/*Federal Programs/Follow-up Studies/*Program Evaluation/Racial Differences/Sex Differences/Urban Areas/Vocational Adjustment/*Work Experience Programs

Identifiers - Neighborhood Youth Corps

The primary criteria for judging Neighborhood Youth Corps (NYC) program effectiveness in Cincinnati, Ohio; Durham, North Carolina; East St. Louis, Illinois; and St. Louis, Missouri, were

community and work adjustments. An experimental group composed of 392 enrollees whose NYC experience was a little more than a year and a control group composed of 205 similar youths who had not enrolled in NYC were interviewed to obtain information on NYC recruitment, work assignments and their value, length of experience, supervision, friendliness of fellow-workers, counselors, useful and disliked aspects of experience, and job placement. The most significant findings were: (1) the program is reaching seriously disadvantaged youth, (2) enrollees reported a high level of satisfaction with their NYC experience, (3) the community and work adjustment of enrollees was improved on several measures, and (4) female enrollees made greater gains than males. Some problem areas concerned the programs' lesser effectiveness with males and white females than with Negro females and the continuing high unemployment rate of ex-enrollees which was probably related to the character of NYC work assignments. Issues needing further exploration included job development, relationships with other manpower programs, remedial education, follow-up counseling, and differential enrollee needs. The extensive appendixes include technical information, the interview schedule, occupational categories, and specific information from the Cincinnati and Durham NYC's. (MM)

ED020045 RC002470

EDUCATING RURAL YOUTH FOR SUCCESS IN THE WORLD OF WORK.

Stutz, Rowan C.; Merrell, Russell G.

Western States Small Schools Project, Salt Lake City, Utah.

Pub Date Dec 67 Note-41p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Career Planning/Community Resources/Comprehensive Programs/Courses/Employer Employee Relationship/Evaluation Methods/Individualized Programs/Industrial Education/Job Training/Occupational Choice/Occupational Guidance/On-the-Job Training/*Program Evaluation/*Rural Education/Rural Environment/Rural Urban Differences/Small Schools/Testing Programs/*Vocational Counseling/Work Attitudes/*Work Experience Programs

Identifiers - Arizona/Colorado/Nevada/New Mexico/Utah

The Career Selection Education (CSE) activities of 14 schools in the western states small schools project are reported. The objectives of the project were to help students in rural areas make realistic career selections, develop an awareness of requisite skills and competencies in a broad spectrum of careers, and develop specific job entry skills. Included is a brief discussion of the effect of rurality on youth, and the inadequacies of rural youth as job seekers on the labor market due to isolation and lack of a comprehensive educational program. Descriptions of the materials and curricula used in the schools, and a definition and description of the duties of the career selection agent placed in each school are provided. Methods and practices used in the adjustment of the regular school program, and in obtaining and making full utilization of community resources are also described. The evaluation consists of student comments and several case studies compiled by career selection agents. Appendices contain samples of the project evaluation battery, the training agreement, and the student rating chart. (DK)

ED015293 VT003855

SUMMER COMMUNITY YOUTH WORK PROGRAM. FINAL REPORT.

Gerard, Robert A.
Action-Housing, Inc., Pittsburgh, Pa.
Pub Date 19 Sep 66 Note-70p.
EDRS Price MF-$0.65 HC-$3.29
Descriptors - Demonstration Projects/*Disadvantaged Youth/Indigenous Personnel/*Neighborhood Improvement/Program Descriptions/*Program Evaluation/Race Relations/Summer Programs/Supervision/Urban Areas/*Work Experience Programs/*Youth Employment
Identifiers - Pennsylvania/Pittsburgh

The program, designed to experiment with new methods of employing youths from low- and marginal-income families, employed 170 youths aged 16 to 21 in improving and developing vacant areas for recreation in declining neighborhoods. The longer range goals of the project were to encourage the youths to prepare themselves for skilled employment and to develop procedures for general application of such a program in urban situations. The program was generally effective with minimal problems of tardiness and absenteeism. However, the progress of work was slow, and morale was low when there was inadequate supervision. The turnover rate was less than 5 percent until the last weeks when students terminated early for return to school, and the less motivated enrollees lost interest. All youths who participated continuously in the program seem to have developed good work habits and adapted to what were in many cases admittedly structured interracial situations. Acquiring basic work skills such as carpentry, bricklaying, masonry, and landscaping was the most visibly enrollee accomplishment. Less tangible achievements were developing a strong sense of responsibility, learning the value of money and one's ability to produce it, and increasing motivation and aspirations. The program was an important influence in strengthening the process of organization in the neighborhoods through the channeling and involvement of community resources. A citizens' evaluation meeting recommended more planning, better supervision, and program extension. (HC)

ED014540 VT000885
COOPERATIVE SUPERVISED JOB TRAINING PROGRAM, THE FINAL REPORT AND EVALUATION.
Illinois State Board of Vocational Education and Rehabilitation, Springfield.; Southern Illinois Univ., Carbondale. School of Teaching.
Pub Date Aug 66 Note-54p.
EDRS Price MF-$0.65 HC-$3.29
Descriptors - Disadvantaged Youth/Dropouts/High Schools/*Low Achievers/Occupations/*On-the-Job Training/*Pilot Projects/Potential Dropouts/*Program Evaluation/Student Characteristics/Vocational Education/Vocational Follow-up/Vocational Schools/*Work Experience Programs
Identifiers - Illinois

A 3-year cooperative supervised job training program was initiated to study the effects of supervised job training on low academic achievers and persons who had definite needs for vocational preparedness immediately upon leaving school. Four schools from three school districts participated in the pilot programs—Robinson High School, Maine Township East and West High Schools, and Drake Vocational Guidance and Education Center. Tables show the percentage of student data supplied on pupil records by each coordinator, objective family statistics, average student dispersion, trends in student hourly wages, hours worked per week, trends in wages for the first and second years of follow-up, and employment follow-up of graduates of the four programs. The findings

generally supported the premise that the program meets the needs of selected students and the needs of the community. The 18 recommendations for improving the program cover record keeping, selection of students and coordinator, use of instructional materials, and correlating techniques. (See VT 000 030 for an interim evaluation.) (PA)

ED012883 AC001406

AN EVALUATION OF APPRENTICESHIP—GROWTH OR STAGNATION, A FRANK DISCUSSION OF GOVERNMENT, UNION, AND INDUSTRY ROLES.

Doyle, Lawrence F.

Pub Date Oct 67

Document Not Available from EDRS.

Descriptors - *Apprenticeships/Employer Attitudes/*Evaluation/Federal Government/*Industrial Training/Industry/Job Skills/*Labor Education/Labor Standards/Labor Unions/Learning Theories/Manpower Development/*Motivation/Program Length/Psychological Needs/Skilled Occupations/Wages/Work Attitudes

Apprenticeship programs, which should provide a continuous supply of craftsmen, are not now alleviating a shortage of skilled labor. Craft unions perpetuate skills shortages by specifying journeymen-apprentice ratios and maintaining a restrictive selection policy. The solution to the problem lies not in federal legislation nor in more formal training procedures, but rather in revitalizing existing structures of apprenticeship from within to stimulate individuals to become more creative, conscientious apprentices. How workers are motivated has been the subject of several psychological studies. When applied to apprenticeship training, these studies pinpoint aspects of the programs that now stifle incentive, including man-hour requirements for each step of training (traditionally lasting from four to six years), standard union wages which do not reward superior performance, and, especially, restricted activities within the job. If the apprentice were given the freedom to progress through the program at his own rate based upon the quality of work he produces, the public would be rewarded by a higher standard of craftsmanship, unions would receive the recognition and status due an organization producing highly trained craftsmen, and the individual would prosper materially and psychologically. This document appeared in *Training and Development Journal,* 21(10)/2/12 October 1967. (AJ)

ED012719 UD002268

REPORT OF THE EVALUATION STUDY OF THE MUNICIPAL COOPERATIVE EDUCATION PROGRAM.

Hamburger, Martin

New York City Dept. of Personnel, N.Y.

Pub Date 07 Apr 65 Note-75p.

EDRS Price MF-$0.65 HC-$3.29

Descriptors - Attitudes/Control Groups/Cooperative Programs/*Disadvantaged Youth/*Dropout Prevention/Interviews/Motivation/Negroes/*Program Evaluation/Puerto Ricans/Questionnaires/*Student Behavior/Tests/Vocational Education/*Work Study Programs

Identifiers - Municipal Cooperative Education Program/New York City

A descriptive evaluation has been made of a New York City cooperative program to motivate potential dropouts and to provide them with supervised, paid employment as an integral part of

their high school experience. The basic study sample was confined to groups, boys and girls, in four predominantly Negro-Puerto Rican high schools in New York City. The Program was evaluated by (1) intelligence, aptitude, achievement, and attitude tests; (2) interviews and questionnaires; (3) on-the-job observations; and (4) other data which included grade, disciplinary, and anecdotal information. For purposes of comparison, a control group was formed. Significantly, the program group averaged a 5.50 IQ-point increase over the 1.55 point increase of the controls. The program group improved in general attitude, attendance, and other nonacademic behavior. However, while the number of high school graduates among the program group exceeded that of the control group, their level of vocational aspiration did not noticeably rise. Their absence on the job and their lateness was greater than that of regular employees. Yet, such an integrated curriculum which incorporates school and job experiences is important in educating unmotivated disadvantaged youth. Appendixes include abstracts of interviews and data on the program participants, content of the program, and administrative concerns. (LB)

AIM/ARM REPORT LITERATURE

VT100972

Peck, A. Daniel

COMMUNITY COLLEGE VOCATIONAL COOPERATIVE EDUCATION. OUTSIDE EVALUATION TEAM REPORT.

Educational Consultants, Palo Alto, Calif.

100

MF Available in VT-ERIC Set, ED 095 434.

OEC-0-71-0527(361)

Pub Date 73

Descriptors - *Cooperative Education/*Community Colleges/*Program Evaluation/*Cooperative Programs/Vocational Education/Technical Education

Abstract - The cooperative education project, undertaken by the five community colleges of the consortium, has attempted to attain a group of general and specific goals and objectives. This evaluation reports on the extent to which it has met them. Its structure is based on three primary goals: (1) curriculum patterns which can be most effective, (2) direct educational improvements as a result of cooperative education, and (3) increased awareness of the community college as an employment resource. In the course of the evaluative process 15 items which represent later emphasis within the project are discussed. Two additional items, student objectives and the changing nature of cooperative education, are presented as concomitant findings. (Author/MU)

VT100348

Gardner, David C.

EMPLOYER EVALUATIONS OF HIGH SCHOOL CAREER EDUCATION COORDINATORS AND STUDENTS: A REPORT TO THE SCHOOL COMMITTEE.

Stoneham Public Schools, Mass.

500

MF Available in VT-ERIC Set, ED 094 270.

Pub Date Feb 73

Descriptors - *Cooperative Education/*Employer Attitudes/*Evaluation Techniques/*Rating Scales/*Secondary School Students/Measurement/Student Evaluation

Abstract - To survey the usefulness of a typical rating scale for the evaluation of a high school career education program, questionnaires were mailed, during the summer of 1972, to 81 employers of the students of Stoneham, Massachusetts Public Schools enrolled in a program offering on-the-job training experiences. Returns from 44 employers indicated the majority of students were rated good or excellent by the employers on all catagories. While almost all employer ratings of coordinators on maturity, adaptability, and business personality were in the good or excellent catagories,

an adequacy of student supervision over 26 percent were poor or fair. Teachers tended to rate students lower than employers on similar characteristics. High positive correlations suggest halo effects in the employers' rating processes, indicating that employers lack proficiency in the proper use of rating scales. This fact points to the need for caution on the part of career educators in the development, utilization, and interpretation of such instruments. (Author/MU)

VT017342

WORK EXPERIENCE EDUCATION RESEARCH FOR ACCOUNTABILITY.

California State Polytechnic Coll., San Luis Obispo.

100

EDRS Price MF-$0.65 HC-$9.87, ED 068 719.

Pub Date 71

Descriptors - *Program Guides/*Work Experience Programs/Educational Accountability/State Programs/Secondary Grades/*Goal Orientation/*Educational Objectives/Resource Materials/*Student Evaluation/Pilot Projects/Vocational Development/Career Education/Individualized Instruction/Performance Criteria/Humanities/Records (Forms)/Gu

Abstract - This extensive color-keyed program guide for general, exploratory, and vocational work experience education programs in California was developed by work experience coordinators, professors, state and local administrators, and various district teams to pilot test at the secondary and university levels. General, exploratory, and vocational goals are given separately, each including specific program goals and performance objectives. Terminal objectives, student performance criteria, and student record sheets provided for pre- and post-assessment purposes separately. Various work experience program forms are included. (AG)

VT016601

Jones, Hilda B.

DIVERSIFIED SATELLITE OCCUPATIONS PROGRAM AND CAREER DEVELOPMENT. INTERIM REPORT—VOLUME I AND VOLUME II (APPENDIX B).

Granite School District, Salt Lake City, Utah.

100

MF Available in VT-ERIC Set, ED 083 482.

OEG-0-70-5176(361)

Pub Date 15 Jun 72

Descriptors - *Pilot Projects/*Vocational Education/*Program Evaluation/*Cooperative Education/Potential Dropouts/Dropout Prevention/Work Study Programs/Elementary Grades/Secondary Grades/*Program Descriptions

Abstract - This experimental program had a 3-fold objective: (1) preventing dropouts, (2) providing career education to dropouts or dropout-prone students, and (3) working for improvements in attitudes toward school and vocational education. On the elementary level, besides general career orientation by all classroom teachers, a pilot program for 6th grade boys identified as potential dropouts has reduced their absences by 80 percent. Occupational orientation programs in the junior high schools attempted to find part-time job experiences for poor risk students. Although not entirely successful, the program generated high student interest. Senior high students in area vocational

centers participated in a work-study program. Some of the students served as teachers' aides in the elementary schools as a "pre-job" placement on an apprentice basis. Field trips, hands-on experience, and teacher in-service were integral parts of all three levels of the program. Appendixes to this report include psychometric assessment procedures and evaluation for the program, a report of a practicum in instructional and curriculum improvement, vocational guidance materials, and a sample of weekly placements. (KH)

VT016303

MARYLAND CAREER DEVELOPMENT PROJECT (K-ADULT). VOLUME I (INTERIM REPORT) AND VOLUMES II-III (SECOND ANNUAL REPORT).

Maryland State Dept. of Education, Baltimore.

MF Available in VT-ERIC Set, ED 070 816.

OEC-0-70-5186(361)

Pub Date 15 Jun 72 221p.

Descriptors - Annual Reports/Developmental Programs/*Career Education/*Vocational Development/Occupational Information/*Program Evaluation/Resource Materials/*Career Opportunities/*Work Experience Programs

Abstract - This second annual interim report for the period July 1, 1971 through June 30, 1972 describes and evaluates the seven project components: (1) elementary career development resource, (2) work-oriented (cooperative), (3) information and placement systems, (4) career exploration workshops, (5) television series, (6) Maryland career development resource notebook, and (7) Maryland career development conference. The most significant accomplishment of the project was that people throughout the state as well as in the operational setting of Baltimore city became aware of the concept of career development and its potential for changes in education. The positive reception toward career education programs in Baltimore city has led to plans for extension of programs in that city and also in 16 local school systems. Volume II of this report contains the detailed project evaluation and Volume III includes surveys, tests, and related measurements. The first annual interim report on this project is available as ED 057 251 or VT 014 418 (ARM, Vol. 5, No. 3). (MF)

VT15031

NEED TO ENHANCE THE EFFECTIVENESS OF ON-THE-JOB TRAINING IN APPALACHIAN TENNESSEE. REPORT TO THE CONGRESS.

Comptroller General of the U.S., Washington, D.C.

MF Available in VT-ERIC Set, ED 068 733.

DOL-B-146879

Pub Date 13 Nov 70 58p.

Descriptors - *Federal Programs/*On-the-Job Training/*Unemployed/*Adult Vocational Education/Employment Programs/*Program Evaluation/Program Effectiveness/Program Improvement/Evaluation Needs

Abstract - A review of on-the-job training activities conducted in Appalachian Tennessee under the Manpower Development and Training Act shows that most of the employers have not changed hiring practices or training procedures as a result of the training contracts. Federal funds used in

the program were dissipated without accomplishing any significant results. These weaknesses result primarily from failure to implement procedures designed to control the program and can be corrected by increasing monitoring. (BH)

VT014677

Currie, Andrfa; Saslow, Michael G.

AN EVALUATION STUDY OF APPRENTICESHIP RELATED TRAINING IN THE STATE OF OREGON.

Oregon State System of Higher Education, Monmouth. Teaching Research Div.

MF Available in VT-ERIC Set, ED 068 733.

Pub Date Oct 71 98p.

Descriptors - *Apprenticeships/*Vocational Education/*Program Evaluation/*Industrial Training/Cooperative Education/*Educational Needs/Trainees

Abstract - This evaluation study analyzes the strengths and weaknesses of apprenticeship related training and the training needs of apprentices enrolled in the apprenticeship training program. Questionnaires were sent to all apprentices, instructors, and joint apprenticeship committee members who were either employers or union members. The findings show that the program needs to be strengthened. Priorities must be set for problems of relevance of instruction, instructor competency, granting of credits for education and experience, effective materials, and learner skills tests based on explicit performance objectives. (BH)

VT013617

A STUDY OF THE EFFECTIVENESS OF A COOPERATIVE EDUCATION PROGRAM.

Army Missile Command, Redstone Arsenal, Ala.

MF Available in VT-ERIC Set, ED 060 223.

Pub Date Jun 70 47p.

Descriptors - *Cooperative Education/*Program Evaluation/*Program Effectiveness/*Student Opinion/Questionnaires/Work Experience Programs/Program Improvement/Vocational Education

Abstract - This study was conducted to determine what can be done to make work assignments for student trainees interesting and challenging enough to assure the maximum retention of these students as full-time employees when they graduate. Included in the report is the co-op questionnaire and the evalution of the results of its administration to 79 student trainees, at all levels of co-op experience and classroom study. (Author/JS)

VT013065

MINORITY PARTICIPATION IN KALAMAZOO'S APPRENTICESHIP TRAINING PROGRAMS: ASSESSMENTS AND RECOMMENDATIONS.

Kalamazoo Public Schools, Mich. Apprenticeship Study Committee.

MF Available in VT-ERIC Set, ED 060 223.

Pub Date Dec 70 71p.

W.E. Upjohn Institute for Employment Research, 300 South Westnedge Ave., Kalamazoo, Michigan 49007 (Single Copies No Charge, Additional Copies $.75 each).

Descriptors - *Apprenticeships/*Program Evaluation/*Minority Groups/*Vocational Education/*Program Attitudes/Job Training/Reports/Public Schools/Standards/Business/Industry/Labor Unions/Trainees

Abstract - This committee report to the school superintendent focuses on the apprenticeship programs for which the Kalamazoo Public Schools furnish related educational instruction. The points for the committee's consideration were to: (1) make sure that positive action was being taken to increase the number of minority group apprentices, (2) determine the likely increase of minority group apprentices in the next two years, (3) provide recommendations for action on the part of business and industry, unions, and the schools to increase the number of minority group apprentices, and (4) determine the feasibility of the Kalamazoo Public Schools to sponsor the training program in light of its policies and philosophy of nondiscrimination. The committee found that positive action, with disappointing results, was being taken and that a fairly small, yet significant, increase could be expected. They recommended that the construction industry give maximum support, that industry and business help increase the awareness of apprentice training opportunities, and that unions make a commitment to the program. Another recommendation was that the Kalamazoo Public Schools definitely continue to sponsor the apprentice training program. (GEB)

VT012350

Ryan, Laverne C.

A COMPARATIVE STUDY OF STATE VOCATIONAL COOPERATIVE AND SIMULATED BUSINESS AND OFFICE PROGRAMS.

Murray State Univ., Ky. Institutional Studies and Research Committee.

MF Available in VT-ERIC Set, ED 057 254.

Pub Date 22 Sep 69 23p.

Department of Business Education, School of Business, Murray State University, Murray, Kentucky 42071 (No Charge).

Descriptors - *Business Education/*Vocational Education/Comparative Analysis/*Program Evaluation/*Cooperative Education/Program Improvement/*Office Occupations Education/Teacher Education/Simulation

Abstract - In an effort to evaluate vocational business education in Kentucky, programs in several other states were examined. Special attention was given to the cooperative office practice programs, the simulated office practice programs, and teacher education requirements. Following the collection and analysis of data it was concluded that the cooperative office training method is the most meaningful to the high school student with the simulated office approach serving as a good substitute where a work experience program is not feasible. It was also noted that there is a need for cooperative training for prospective business education teachers. (JS)

VT011568

Weinhold, Ray

SYNTHESIS OF RESEARCH AND EXPERIENCE IN COOPERATIVE WORK-STUDY VOCATIONAL EDUCATION PROGRAMS.

Arizona Occupational Research Coordinating Unit, Phoenix.

MF Available in VT-ERIC Set, ED 049 385.
17p.
Descriptors - *Vocational Education/*Cooperative Education/Work Experience Programs/*Program Evaluation/Research Coordinating Units/*Educational Research/Program Planning/*Educational Change

Abstract - A review and synthesis of research and experience concerning cooperative work-study programs revealed a number of findings. The seven types of programs currently being offered include business and office procedure, distributive services, home economics, trade and industrial skills, off-farm agricultural businesses, interrelated programs, and special purpose programs. Though the seven areas are each designed to teach a different skill, much similarity exists among the areas, the most common element being paid employment. The number of programs is growing rapidly, though the number of students currently participating is small. Evidence indicates that advantages of a cooperative program far outweigh disadvantages for students, employers, and schools. However, research revealed that such programs are not inexpensive and that better evalution procedures are needed as well as consensus concerning some vital questions about cooperative programs. (SB)

VT008885
Bennett, Robert
COOPERATIVE-DISTRIBUTIVE EDUCATION; AN ALTERNATE SEMESTER PROGRAM.
College of San Mateo, Calif.; California State Dept. of Education, Sacramento. Bureau of Business Education
MF Available in VT-ERIC Set, ED 037 585.
Pub Date 68 13p.
Descriptors - *Program Descriptions/*Distributive Education/*Cooperative Programs/Educational Planning/*Curriculum/Work Study Programs/Junior Colleges/*Program Evaluation/Distributive Occupations/Employer Attitudes/Student Attitudes/Recruiting

Abstract - The purpose of this study was to determine the feasibility of using the cooperative education plan in junior colleges for students seeking distributive careers. The study is limited to students from College of San Mateo during spring semester of 1968 and employers in the San Francisco Bay area. Section I provides a summary of new information gained through the study, summarizes the responses of 50 employers who were interviewed, and provides civilian employment statistics for the San Francisco Bay area. Section II describes the alternative semester cooperative education work-study plan for college students. Included are summaries of previous studies and a brief historical sketch of this movement in education. Section III summarizes reports from participants in the initial pilot program. Direct reports of students and employer statements about the cooperative education-distributive alternating semester plan supplements the presentation of statistical data. (CH)

VT008692
WORK-EXPERIENCE EDUCATION IN SANTA BARBARA COUNTY HIGH SCHOOL DISTRICTS. AN EVALUATIVE STUDY.
Santa Barbara County Association of Work-Experience Educators, Calif. Evaluative Study Committee

MF Available in VT-ERIC Set, ED 039 370.
Pub Date May 69 100p.
Descriptors - *Work Experience Programs/*High Schools/*Program Evaluation
Abstract - The purposes of the study were: (1) to describe the nature of the program; (2) to evaluate the purposes, procedures, and outcomes; (3) to identify problems, issues, and strengths; (4) to recommend basic principles which should govern procedures involved in the continuance and improvement of the program; and (5) to evaluate the implementation of the recommendations of a 1961 study of similar nature. In October 1968, 1,747 questionnaires were sent to principals, counselors/coordinators, teachers, counselors, students, employers, and parents. Usable responses totaled 1,000. Programs had become more extensive than they were in 1960 and were generally recognized as valuable. Important deficiencies were insufficient supervisory visits to job stations and inadequate relationships between job and school experiences. Recommendations include: (1) organizing of effective advisory committees, (2) employing sufficient staff to direct the program and coordinate jobs, (3) classifying students in accordance with program type (exploratory, vocational, general), (4) providing an effective orientation program for 10th grade students, (5) providing related instruction for all students in the programs, (6) solving transportation problems, (7) increasing emphasis on vocational guidance prior to job placement, and (8) implementing a continuous public relations program. (JK)

VT008581
Cudney, Robert F.
WORK ORIENTATION PROGRAM, 1965-1968. FINAL REPORT.
Illinois Research and Development Coordinating Unit, Springfield; Township High School District 214, Mount Prospect, Ill.
MF Available in VT-ERIC Set, ED 039 370.
Pub Date 68 183p.
Descriptors - *Disadvantaged Students/*Cooperative Education/*Prevocational Education/*Program Evaluation/*Program Descriptions/Interagency Cooperation/High School Students/Program Administration/Student Personnel Services/Program Content/Course Organization/Post Testing/Pretesting
Abstract - This academic and prevocational program was a coordinated effort to increase the self-sufficiency and employability of physically and mentally handicapped youth. The 4-year program for students 15 to 19 years of age included: (1) social-vocational evaluation in education, (2) prevocational and in-school work experience, (3) on-the-job adjustment training in the community, and (4) placement and follow-up. This report summarizes the first 2 years and presents details of the third year in the areas of (1) work orientation, (2) philosophy and objectives, (3) student selection, (4) evaluations of technical processes, enrichment, buildings, counseling, science, and English and reading, (5) program studies, (6) workshop reports, (7) dissemination of information, and (8) the division of vocational rehabilitation. (FP)

VT008412
EVALUATION OF WORK SCHOLARSHIP PROGRAM.
District of Columbia Public Schools, Washington, D.C. Dept. of Research, Budget, and Legislation

MF Available in VT-ERIC Set, ED 039 370.

Pub Date Jun 67 28p.

District of Columbia Public Schools' Division of Planning, Innovation and Research, 415 12th Street, N.W., Washington, D.C. 20004 (No Charge).

Descriptors - *Work Experience Programs/*Dropout Prevention/*Program Evaluation/*High Schools/School Surveys/Family Background/Grades (Scholastic)/Wages/Attendance Patterns/Conduct/*Student Improvement/Student Characteristics

Abstract - This report concerns two studies of work scholarship program participants in the junior and senior public high schools of the District of Columbia. The first report used a sample of 286 participants during 1964-65 and 1965-66 and sought (1) to determine the effectiveness of this program in aiding students to stay in school, and (2) to evaluate the effects that program participants had on indicators of school motivation and achievement. Data show that the program has been effective in reducing dropout rates at a statistically significant level; however, other factors, such as scholarship, deportment, and attendance, were not improved. A second study was made of 518 participants during the 1966-67 school year in order to determine how the work scholarship pay was spent. Finding indicated that most students used their earnings for essential items such as food and clothing, school supplies, and participation in various school activities. Recommendations for future evaluations suggest concentration on actual performance changes of participating students. (CH)

VT005565

Vambery, Eva

EVALUATION OF THE MUNICIPAL COOPERATIVE EDUCATION PROGRAM—A REPORT OF THE 1962-1963 TRAINEES.

Center for Urban Education, New York, N.Y.

MF Available in VT-ERIC Set, ED 036 657.

Pub Date 30 Oct 69 158p.

Descriptors - *Graduate Surveys/*Program Evaluation/*Work Experience Programs/Work Environment/*Student Attitudes/Program Descriptions/Employment Programs/Participant Satisfaction/Follow-up Studies/Control Groups/Experimental Groups/Questionnaires/Interviews

Abstract - The Municipal Cooperative Education Program (MCEP) was a work-study program for volunteer students who were selected on the basis of inadequate level of academic achievement and financial need. Entry jobs were provided in the city departments in clerical, park or hospital areas. Students who participated worked every other week full-time and took special double classes in the general education curriculum for the week they didn't work. A sample of MCEP students (30) and a control group (10) of students who did not participate were interviewed in 1966. Some of the findings were: (1) MCEP made a positive contribution to the curriculum of the general diploma candidate as an opportunity for steady remunerative work experience and association with adults, (2) in the absence of formal vocational training a majority of the cooperative students held unskilled jobs which offered no training opportunity, (3) immediate benefits from work experience tended to be negated by a lack of basic education, leading students to different avenues of occupations or learning after high school, and (4) both trainees and control students seemed in great need of counseling while in high school because they did not understand the ramifications of their own actions. One of the recommendations was that the character of the trainee job should be reviewed, since jobs which the student finds degrading, uninstructive, and which he cannot easily leave may be damaging. (MM)

VT004016

Benjamin, Gerald R.

SIGNIFICANT JOB SUCCESS FACTORS FOUND IN WORK-STUDY PROGRAMS IN FIVE MAJOR NEW YORK STATE CITIES. FINAL REPORT.

New York State Education Dept., Albany. Bureau of Occupational Education Research; Syracuse Univ., N.Y. Div. of Special Education and Rehabilitation

MF Available in VT-ERIC Set, ED 030 001.

BOR-2

Pub Date Jul 67 323p.

Descriptors - *Work Study Programs/*Program Evaluation/Graduate Surveys/Student Attitudes/Grade Point Average/Program Administration/Counseling Effectiveness/Job Tenure/*Success Factors/Urban Schools/*High School Graduates/*Employment/*Vocational Education/Mentally Handicapped/Program Descriptions

Abstract - The purpose of the study was to identify aspects found in secondary school vocational study programs that seem to be closely related to graduates' job success. Five variables relating to the work-study programs and four variables relating to job success were used as criteria in determining which graduates had been the most occupationally successful. Data were received from a random 20 percent of 246 of the graduates who participated in the vocational work-study programs in five major city school districts. Of the 20 hypotheses tested, only two were found to be significant at the .05 level of confidence: (1) the students' grade point averages will have a positive relationship to the *Dictionary of Occupational Titles* classification of graduates' jobs, and (2) assignment of students to work-study job stations related to their major field will be related to the proportion of students' time employed after graduation. Some of the findings relating to the programs were: (1) approximately 76 percent of the sample felt the program had helped them since graduation, (2) approximately 80 percent felt they did better in school work while in the program, (3) only 21 percent of the males and 70 percent of the females were placed in work-study program situations complimenting and extending their vocational programs, and (4) relative minor emphasis was given to the guidance function of the five work-study programs. Data relating to employment revealed that (1) about 69 percent had a job when they left school upon graduation and an additional 12 percent found jobs within 30 days, (2) approximately 82 percent were earning more than $1.51 per hour, and (3) the graduates' success on the job related to placement in jobs for which they had received specific training. A summary of the study is given in VT 005 269. (MM)

VT002010

Haines, Peter G.

HOW HIGH SCHOOL COOPERATIVE TRAINEES FARE IN THE LABOR MARKET PHASE B, A FOLLOW-UP STUDY OF 1963 GRADUATES TEN MONTHS AFTER GRADUATION, AND A LIMITED SAMPLE OF 1962 GRADUATES TWO YEARS AFTER GRADUATION.

Michigan State Univ., East Lansing. Coll. of Education

MF Available in VT-ERIC Set, ED 036 657.

ER-23

Pub Date May 65 72p.

Descriptors - *Vocational Follow-up/*Cooperative Programs/Longitudinal Studies/*Graduate Surveys/*Program Evaluation/Employment Patterns/Wages/Occupational Mobility/Cooperative Education/*Vocational Education

Abstract - The major areas of interest were: (1) employment status of trainees, (2) degree to which trainees remained in fields of training, (3) degree to which trainees remained in same locality, (4) type of industry in which trainees were employed, (5) average income of trainees, (6) academic quality of trainees. Of the 4,036 June 1963 graduates, 1,472 or 36 percent returned usable questionnaires, and 1,855 of the June 1962 graduates who responded in 1963 returned 516 or 28 percent return. Conclusions were: (1) vocational education through the cooperative plan results in trainees locating and retaining employment after graduation, (2) cooperative firms have profited because numbers of trainees have remained with them as regular employees, (3) cooperative education programs do not curtail further education in post-high school educational institutions. (MM)

NTIS REPORT LITERATURE

AN ECONOMETRIC ANALYSIS OF THE COSTS OF SELECTED MANPOWER PROGRAMS

Indiana Univ., Bloomington. Dept. of Economics. *Manpower Administration, Washington, D.C. Office of Policy, Evaluation and Research.

Final Report

Author: Stromsdorfer, Ernst W.; Moayed-Dadkhah, Kamran; Oudet, Bruno A.

C4604H1 FLD: 05I, 05C, 70D, 92A USGRDR7512

Apr 74 134p.

Grant: OEO-CG-5644

Monitor: MFL-74-08

Abstract: The report is a cost analysis of four manpower training programs: MDTA-Institutional; Job Corps; NYC-Out-of-School; and NAB-JOBS. Total cost functions are estimated as well as wage functions to estimate opportunity costs. Private and social average and marginal cost estimates are provided. The data, however, do not represent estimates of costs for the national programs; rather they are cost estimates for a judgment sample of projects.

Descriptors: *Manpower programs, *Cost analysis, Social welfare, Services, National government, Economic analysis, Econometrics

Identifiers: Neighborhood Youth Corps, Job Corps, Job opportunities in the business sector, MDIA (Manpower Development and Training Act), Manpower Development and Training Act, NTISLABMPE

PB-240 737/7ST NTIS Prices: PC$5.75/MF$2.25

AN EXAMINATION OF THE RELATIONSHIP BETWEEN A MEASURE OF PSYCHOLOGICAL WELL-BEING AND A MEASURE OF MANPOWER PROGRAM SUCCESS

TEAM Associates, Inc., Washington, D.C. *Department of Health, Education, and Welfare, Washington, D.C. Office of the Assistant Secretary for Planning, and Evaluation.

Final Report

Author: Block, A. Harvey

C4594B3 FLD: 05I, 05J, 70D, 92B USGRDR7512

Feb 75 92p.

Contract: HEW-OS-74-186

Monitor: ASPE-75-006

Abstract: The relationship between psychological well-being, staying in a program and self-evaluation of the program was studied on 7000 enrollees in MDTA, JOBS, Job Corps, and NYC. Although sex, age, marital status, type of program, and prior arrest record were significantly related to mean length of program stay, psychological well-being alone was an exceptionally accurate predictor of the proportion of enrollees remaining in a program for any given length of time. With the

partial exception of JOBS, the programs had limited "holding power" on enrollees. Race was not related to length of program stay.

Descriptors: *Manpower programs, Emotions, Human behavior, Attitudes, Learning, Morale

Identifiers: Dropouts, Job Corps, Neighborhood Youth Corps, Job opportunities in the business sector, Manpower Development and Training Act, NTISHEWPPE

PB-240 391/3ST NTIS Prices: PC$4.75/MF$2.25

AN INVESTIGATION OF THE INFLUENCE OF THE IN-SCHOOL NEIGHBORHOOD YOUTH CORPS ON EMPLOYMENT AND EARNINGS IN HOUSTON, TEXAS

Houston Univ., Texas. Dept. of Economics. *Manpower Administration, Washington, D.C. Office of Research and Development.

Final Report. 1972-74

Author: Ellard, Charles J.

C3705A2 FLD: 5K, 92C USGRDR7425

9 Apr 74 169p.

Grant: DL-91-48-72-05

Monitor: DLMA-91-48-72-05-1

Abstract: A study investigates the post-high school influence of the In-School Neighborhood Youth Corps on labor force performance and educational attainment of 142 Houston youths. This sample consists of 103 former participants in the NYC Program and 39 controls selected from siblings of NYC participants. The NYC participants include 83 school year subjects and 20 summer-only participants. The analysis of the sample data attempts to measure the NYC influence on post-high school performance variables using multiple regression analysis to control for several other factors: including age, race, sex, marital status and parental education. The investigation also probes for NYC influence within racial groups and for the sexes taken individually. Additional investigations vary structure of the experimental variables and look at the influence of program component.

Descriptors: *Youths, *Labor force participation, *Employment surveys, Texas, Personnel development, Projects, Organizational effectiveness, Demographic surveys, Program review, Performance evaluation

Identifiers: *Neighborhood Youth Corps, In-school youth programs, *Houston (Texas), NTISLABRDU

PB-236 219/2ST NTIS Prices: PC$6.25/MF$2.25

IN-SCHOOL NEIGHBORHOOD YOUTH CORPS 14/15 YEAR-OLD BLACK TEENAGE GIRL PROJECT, MEMPHIS, TENNESSEE

Memphis Board of Education, Tenn. *Manpower Administration, Washington, D.C. Office of Research and Development.

Final Report

Author: Fox, Andrew; May, W. Theodore; Schwartz, Paul L.

C3704G4 FLD: 5I, 70D USGRDR7425

3 Feb 74 175p.

Grant: DL-42-47-73-01

Monitor: DLMA-42-47-73-01

Abstract: The study analyzes the effects on 14/15 year-old black girls of entering and participating in a specially designed work program. The girls were provided with supports in their work settings, including well-defined tasks, supervisors, and regularly scheduled peer interaction groups led by young black women considered to be appropriate role models. Personality assessment data and external source data on behavior were collected and analyzed, on an experimental group and two control groups the results are discussed. The special supports designed for the experimental group resulted in differential results when compared with the control groups. The experimental group maintained their levels of functioning, whereas a control group of the same age did not show comparable maintenance of functioning. Leavers from the experimental group showed particularly negative outcomes.

Descriptors: *Manpower programs, *Youth, *Females, *Negroes, Specialized training, Employment programs, Group dynamics, Performance evaluation, Research and methodology, Tennessee

Identifiers: *Neighborhood Youth Corps, *Memphis (Tennessee), In-school adolescents, NTISLABRDU

PB-236 184/8ST NTIS Prices: PC$6.25/MF$2.25

DEVELOPMENT OF ASSESSMENT MEASURES FOR USE WITH YOUTH-WORK TRAINING PROGRAM. PHASE II: LONGITUDINAL VALIDATION

Educational Testing Service, Princeton, N.J. (122 250)

Final Report

Author: Freeberg, Norman E.

C2824F4 FLD: 5I, 5J, 92A, 92B USGRDR7412

Jan 74 74p.

REPT NO: PR-74-1

Contract: DL-41-9-005-32

Monitor: DLMA-41-9-005-32-2

See also Phase I, PB-231 521.

Abstract: A battery of tests, designed expressly for use in assessment of disadvantaged adolescents enrolled in youth-work training programs, was validated predictively against both short-term (program completion) and longer-term (post-program) behavioral outcome dimensions. Measures of the battery displayed their best validities with such longer-term criterion dimensions as social and vocational adjustment, job success and satisfaction, and job search motivation. The most valid test were three practical reasoning measures (i.e., skill at following directions in job tasks); three vocational orientation measures (i.e., knowledge of job requirements and skill at seeking and holding jobs); and two attitudinal measures (self-esteem and attitude toward authority).

Descriptors: *Training programs, *Youths, *Psychological tests, Test construction (Psychology), Proving, Criteria, Social characteristics, Vocational interests, Adjustment (Psychology), Job satisfaction, Motivation, Reasoning, Attitudes

Identifiers: *Disadvantaged youth, *Neighborhood Youth Corps, OMPER

PB-231 522/4 NTIS Prices: PC$3.75/MF$1.45

METHODOLOGY FOR MEASURING COST-EFFECTIVENESS OF MANPOWER PROGRAMS: DEVELOPMENT AND APPLICATION

Unco, Inc., Washington, D.C.

Final Report. May 71-Aug 73.

C2313E4 FLD: 5I, 70D USGRDR7406

15 Aug 73 152p.

Contract: DL-43-1-005-11

Monitor: MEL-74-03

Abstract: Using a methodology which was developed earlier, national Job Corps data were analyzed. The report presents the results of that analysis in terms of: (1) the extent to which vocational training, basic education, and counseling improve effectiveness of training as a whole, and at what cost; (2) duration of training, and the existence of a point of diminishing returns beyond which centers should not continue training of a corps member; and (3) whether the residential component of Job Corps appears worth the extra cost.

Descriptors: *Industrial training, *Youths, *Evaluation, *Effectiveness, Projects, Vocational guidance, Education, Counseling, Cost effectiveness, Cost analysis, Time, Manpower utilization, Computerized simulation, Mathematical models

Identifiers: *Jobs Corps, Diminishing returns, Disadvantaged youth, Cost effectiveness models, OMPER

PB-226 862/1 NTIS Prices: PC$5.00/MF$1.45

AN ECONOMIC ANALYSIS OF THE WORK EXPERIENCE AND CAREER EXPLORATION PROGRAM: 1971-1972 SCHOOL YEAR

Indiana Univ., Bloomington. Dept. of Economics.

Final Report

Author: Stromsdorfer, Ernst W.; Fackler, James S.; Felton, Marianne V.; Kelcher, Robert E.

C1655G2 FLD: 5I, 70D USGRDR7321

Jul 73 238p.

Contract: DL-82-18-71-29

Monitor: DLMA-82-18-71-29-2

Abstract: The report presents a nationally study of the Work Experience and Career Exploration Program as it was in operation nationally during the 1971-72 school year. The study suggests that limited labor market experience during school hours can improve the educational performance of 14- and 15-year-old students who are dropout prone or who suffer educational disabilities.

Descriptors: (*Manpower utilization, *Youths), (*Education, *Motivation), Industrial relations, Specialized training, Projects, Students, Evaluation, United States

Identifiers: Career development, Labor market, OMPER

PB-223 366/6 NTIS Prices: PC$5.75/MF$1.45

A LONGITUDINAL STUDY OF SELECTED OUT-OF-SCHOOL NYC-2 PROGRAMS IN FOUR CITIES. (AN EVALUATION OF THE 1972 WASHINGTON SUMMER INTERN PROGRAM OF THE DEPARTMENT OF LABOR)

George Washington Univ., Washington, D.C. Manpower Research Projects.

Report No. 1 (Final)
Author: Walther, Regis H.; Magnusson, Margaret L.; Cherkasky, Shirley E.
C1425J1 FLD: 5I, 92D USGRDR7318
Feb 73 205p.
Contract: DL-41-0-003-09
Monitor: DLMA-41-0-003-09-3

Abstract: The 1972 Washington Summer Intern Program was a special work experience, underwritten by the Department of Labor, for approximately 100 young people—high school juniors, for the most part—who came to Washington from many places in the United States. The program was operated by three sponsors for three ethnic groups: Spanish-Speaking, Black, and Native Americans. Although the specific objectives of the operating sponsors varied to some extent, each had goals related to helping interns in their career planning and preparations and in their knowledge of government operations and service. Results indicated that although there were many differences between the programs operated by the three sponsors, Interns were nearly unanimous in very high appreciations of the overall usefulness of their experience. Other study results indicated that the experience had been effective in career-related and knowledge-of-government program goal areas.

Descriptors: (*National government, *Public relations), (*Specialized training, *Youths), (*Employment, Summer), Projects, Negroes, Spanish speaking Americans, Caucasians, Evaluation, Objectives, Reviews, Organizations, Effectiveness

Identifiers: *Summer intern programs, Neighborhood youth corps, High school students, Understanding, OMPER

PB-222 323/8 NTIS Prices: PC$5.50/MF$1.45

NYC (NEIGHBORHOOD YOUTH CORPS) SUMMER (IN SCHOOL) GOES TO COMMUNITY COLLEGE

Evaluation Technology Corp., Camarillo, Calif.
Final Report
Author: McDaniel, John W.
C1271C4 FLD: 5I, 92D, 92E USGRDR7316
15 Feb 73 106p.
Contract: DL-42-0-001-05, DL-42-9-003-05
Monitor: DLMA-42-0-001-05-5

Abstract: NYC Goes To Community College is a combined work and study program for economically disadvantaged youth cooperatively conducted by local sponsors of Neighborhood Youth Corps and community colleges. The target population served by these programs was composed of NYC eligible, junior or senior year in high school, youth. Including the 1972 summer, over 10,000 NYC youth participated in the program which grew from one pilot model in 1968 to 28 separate programs in 1972. NYC enrollees earned wages for work on campus jobs, and earned credit in college courses. Costs were shared.

Descriptors: (*Education, *Youths), (*Employment, Youths), Universities, Motivation, Upgrading, Students, Vocational guidance, Summer, Work sampling, Effectiveness, Reviews, Cooperation, Social welfare

Identifiers: *Disadvantaged youth, Neighborhood Youth Corps, OMPER

PB-220 914/6 NTIS Prices: PC$3.00/MF$0.95

The Experimental Manpower Laboratory's Research and Demonstration Pursuits from December 16, 1970 through December 15, 1972 and R and D Projects to be Undertaken from December 16, 1972 through April 15, 1974: THE DEVELOPMENT AND EVALUATION OF INNOVATIVE STRATEGIES FOR ENHANCING THE MEANINGFULNESS, GAINFULNESS AND STABILITY OF EMPLOYMENT FOR THE HARD-TO-EMPLOY

Mobilization for Youth, Inc., New York. The Experimental Manpower Lab.

Final Report

Author: Feifer, Irwin

C0351A3 FLD: 5I, 5K, 92A, 92C USGRDR7305

3 Nov 72 675p.*

Contract: DL-82-36-71-07

Monitor: DLMA-82-36-71-07-21

Abstract: The report presents a detailed review of activities and developments-to-date of R and D projects pursued by the MFY-EML from 12/70-12/72, as well as R and D projects to be pursued from 12/72 to 4/74. The individual projects fall under five broad categories. Emergent types of publications from 1970-72 R and D activities are classified in accordance with their nature and intended audiences.

Descriptors: (*Manpower utilization, *Projects), (*Social welfare, *Project planning), Demographic surveys, Sociopsychological surveys, Socioeconomic status, Questionnaires, Specialized training, Industrial training, Management training, Youths, Employment, Counseling, Aptitude tests, Ethnic groups, Motivation, Drug addiction, Upgrading

Identifiers: Disadvantaged youth, career development, Research and development, Hard to employ groups, Neighborhood Youth Corps

PB-214 163/8 NTIS Prices: PC$9.00/MF$0.95

FULFILLING THE POTENTIAL OF NYC (NEIGHBORHOOD YOUTH CORPS)-2. TOWARD AN EXPANDED DEFINITION OF ASSESSMENT: I. THE DETERMINATION OF VIABLE JOB TRAINING AREAS

Mobilization for Youth, Inc., New York. The Experimental Manpower Lab.

Author: Seldin, Joel R.

C0342K2 FLD: 5I, 70D, 92A USGRDR7305

Nov 72 48p.

Contract: DL-82-36-71-07

Monitor: DLMA-82-36-71-07-27

Report No. 17 on Manpower Monograph Series on Disadvantaged Youth.

Abstract: An expanded concept of manpower development assessment has as its first step the job market assessment of potential job categories before they are selected by NYC-2 programs as training areas. NYC-2 staffs, through their selection of training and job opportunities for enrollees, exert a critical influence on the lives of these youths. The choice must be made carefully and responsibly, avoiding such common errors as arbitrary decisions that make sense to staff members or enrollees, but are not realistic in labor market projections. Statistical reports of job vacancies by state and federal agencies are a way to start, but they rarely provide enough information for planning purposes. Therefore, programs have to conduct their own job market surveys. The monograph describes a survey conducted by the Experimental Manpower Laboratory at Mobilization for Youth to illustrate considerations necessary in a survey, and includes the interview schedule developed by

MFY-EML. It concludes with an explanation of how the survey data is used to determine whether the job category surveyed is appropriate for inclusion into an NYC-2 program.

Descriptors: (*Manpower utilization, *Youths), (*Industrial training, Manpower utilization), Project planning, Surveys, Evaluation, Job analysis, Specialized training, Optimization, Management planning

Identifiers: *Neighborhood Youth Corps, *Disadvantaged youth, *Job market assessments, *Training category selection

PB-213 989/7 NTIS Prices: PC$3.00/MF$0.95

FULFILLING THE POTENTIAL OF NYC (NEIGHBORHOOD YOUTH CORPS)-2. GUIDELINES FOR EFFECTIVE PLACEMENT AND FOLLOW-UP ON OUTSTATIONED NYC-2 JOB TRAINING SITES

Mobilization for Youth, Inc., New York. The Experimental Manpower Lab.

Author: Reinish, Harold

C0342J4 FLD: 5I, 70D, 92A USGRDR7305

Nov 72 25p.

Contract: DL-82-36-71-07

Monitor: DLMA-82-36-71-07-23

Report No. 16 on Manpower Monograph Series on Disadvantaged Youth.

Abstract: Follow-up information on a trainee's progress at a dispersed work experience-training site is necessary to be able to evaluate his progress, to ascertain if the dispersed training/work experience site is providing the appropriate experiences called for in the NYC-2 employability plan and to help the agency modify its own programs to meet the demands of the world of work. It also helps maintain a relationship with the trainee during a critical period in his vocational life. The field visit is discussed as the best technique and one which requires a knowledge of the organizational structure and protocol at the training site.

Descriptors: (*Manpower utilization, Youths), (*Youths, Placement), Performance evaluation, Requirements, Feedback, Measurement, Human behavior, Interviews, Investigations, Questionnaires

Identifiers: *Neighborhood Youth Corps, *Disadvantaged youth, Follow-up programs, Field visits, Project modifications

PB-213 987/1 NTIS Prices: PC$3.00/MF$0.95

FULFILLING THE POTENTIAL OF NYC (NEIGHBORHOOD YOUTH CORPS)-2. REFINING NYC-2 GUIDELINES: TOWARD AN EXPANDED DEFINITION OF ASSESSMENT

Mobilization for Youth, Inc., New York. The Experimental Manpower Lab.

Author: Seldin, Joel R.

C0342J2 FLD: 5I, 70D, 92A USGRDR7305

Nov 72 27p.

Contract: DL-82-36-71-07

Monitor: DLMA-82-36-71-07-22

Report No. 14 on Manpower Monograph Series on Disadvantaged Youth.

Abstract: NYC-2, to implement its new objective of positive job placement for enrollees in realistic, career-oriented employment, calls for changes in program design to include specific

job-related skills for verified employment opportunities. This major design change was ordered by altering NYC Standards, the regulations that guide NYC operators. Under the new concept, all factors affecting program require intensive and related assessment. Flow of the assessment process starts with the labor market and jobs, proceeds through program services, and ends with enrollees characteristics.

Descriptors: (*Manpower utilization, *Youths), (*Project planning, Manpower utilization), Concepts, Objectives, Management planning, Employment, Standards, Evalution, Information systems, Vocational guidance

Identifiers: *Neighborhood Youth Corps, *Disadvantaged youth, Guideline development

PB-213 985/5 NTIS Prices: PC$3.00/MF$0.95

A SURVEY OF RECENT LITERATURE RELEVANT TO OPTIMIZING THE BENEFITS OF YOUTH PROJECTS FOR RURAL YOUTH IN THE SOUTHEASTERN STATES

North Star Research and Development Inst., Minneapolis, Min. (387 160)

Final Report

Author: Rogoff, Barbara M.; Schneider, William J.; Miles, Guy H.

A5494K1 FLD: 5I, 70D, 92F USGRDR7224

Aug 72 58p.*

Contract: DL-41-2-001-27

Monitor: DLMA-41-2-001-27

Abstract: A review was made of more than 140 publications which deal with the occupational and social adjustment of rural youths in the Southeastern region. This review focuses on publications that concern the changing economic environment of rural youths, their migration patterns, their educational system, their participation in federal manpower programs, and their occupational and social adjustment.

Descriptors: (*Youths, Rural areas), (*Socioeconomic status, *Southern states), Reviews, Demographic surveys, Economic surveys, Ethnic groups, Employment, Adjustment (Psychology), Hypotheses, Population migrations, Social change, Education, Industrial training, Manpower utilization, Projects, Evalution, Statistical data, Optimization

Identifiers: Benefits

PB-212 562 NTIS Prices: PC$3.00/MF$0.95

EVALUATION OF THE 1971 NEIGHBORHOOD YOUTH CORPS SUMMER RECREATION SUPPORT PROGRAM

Training, Research and Development, Inc., Washington, D.C.

Phase 1 (Final) Aug-Nov 71

Author: Williams, Robert A.; Pinckney, Obie, Jr.

A4022L2 FLD: 5K, 53D USGRDR7209

Jan 72 65p.

Contract: DL-83-42-72-02

Monitor: MFL-72-01

Abstract: The report is a comprehensive evaluation of the 1971 Neighborhood Youth Corps summer recreation support program. This evaluation was made by sampling 22 of the 111 cities

participating in the program so that a model or plan with the necessary supportive materials could be developed to facilitate future program development in the areas of planning, management, staff training and program content. The evaluation effort was directed toward determining how the program guidelines and national and regional guidance affect the function and effectiveness of the program, determining how well the program is being administered and managed at city levels, and determining the effectiveness of the Recreation Support Program as it is now being conducted.

Descriptors: (*Recreation, Project planning), Summer, Urban areas, Surveys, Management planning, Evaluation, Objectives, Recommendations, Recreational facilities

Identifiers: *Neighborhood Youth Corps, Disadvantaged youth

PB-207 340 NTIS Prices: PC$3.00/MF$0.95

EVALUATION RESULTS FOR THE LOS ANGELES WOMEN'S JOB CORPS CENTER

Rand Corp., Santa Monica, Calif. (296 600)

Final Report

Author: Carroll, Stephen J.; Greenberg, David H.; Katsky, Patricia O.

A3911H4 FLD: 5I, 56N USGRDR7208

Sep 71 83p.

Report No.: R-745-OEO

Contract: OEO-4191

Monitor: OEO-LN-1055

Abstract: The report presents a study of the effectiveness of an experimental commuter program operated by the Los Angeles Women's Job Corps Center in terms of corpswomen's cognitive gains, changes in corpswomen's work-relevant attitudes, and the length of time that corpswomen remained in the Center. (Author)

Descriptors: (*Education, Women), (*Employment, Women), Evaluation, Projects, Effectiveness, Attitudes, Socioeconomic status, Counseling, Vocational guidance, Statistical data

Identifiers: Job Corps, *Women's Job Corps Center, *Los Angeles (California), Experimental commuter programs

PB-207 196 NTIS Prices: PC$3.00/MF$0.95

EVALUATION DESIGN FOR THE LOS ANGELES WOMEN'S JOB CORPS CENTER

Rand Corp., Santa Monica, Calif. (296 600)

Author: Carroll, Stephen J.; Katsky, Patricia O.; Kleiger, Linda; Pascal, Anthony H.; Press, James

A3911H3 FLD: 5I, 56N USGRDR7208

Dec 70 118p.

Report No.: RM-6373-OEO

Contract: OEO-4191

Monitor: OEO-LN-1056

Abstract: The report presents a study to evaluate the relative contributions of the program components of an experimental commuter program of the Los Angeles Women's Job Corps Center (Author)

Descriptors: (*Education, Women), (*Employment, Women), Evaluation, Projects, Socio-economic status, Attitudes, Counseling, Vocational guidance, Statistical data

Identifiers: Job corps, *Women's Job Corps Center, *Los Angeles (California), Experimental commuter programs

PB-207 195 NTIS Prices: PC$3.00/MF$0.95

SUMMER NYC GOES TO A COMMUNITY COLLEGE. REPORT OF AN EXPERIMENTAL DEMONSTRATION PROJECT

Evaluation Technology Corp., Camarillo, Calif.

Final Report

Author: McDaniel, J. W.; Lawson, William H.; Lombardi, Robert A.; Moore, Richard L.

A3042F2 FLD: 5I, 56E USGRDR7122

1971 29p.*

Contract: DL-42-0-001-05

Monitor: DLMA-42-0-001-05-1

Abstract: A report is presented on the procedures and outcomes of NYC (Neighborhood Youth Corps) programs conducted on community college campuses. During the summer of 1969, twelve community colleges in California cooperated with local NYC sponsors to operate work-study programs. In 1970, this effort was extended to 5 cities in 5 states. The report describes the 1970 program and its outcomes with those of the 1969 program to develop a program model, a supportive rationale, and a collection of tested guidelines for nationwide implementation. (Author)

Descriptors: (*Education, Universities), (*Employment, Project management), Students, Standards, Learning, Manpower, Motivation

Identifiers: Neighborhood Youth Corps, Community colleges

PB-202 931 NTIS Prices: PC$3.00 MF$0.95

FULFILLING THE POTENTIAL OF NYC-2. INTEGRATING REMEDIAL EDUCATION INTO NEIGHBORHOOD YOUTH CORPS TRAINING PROGRAMS

Mobilization for Youth, Inc., New York. The Experimental Manpower Lab.

Final Report

Author: Schenkman, Jerome G.

A2315F1 FLD: 5I, 56E USGRDR7114

Jul 70 22p.

Contract: DL-82-34-69-21

Monitor: DLMA-82-34-69-21-2

Abstract: The report consists of four monographs which serve as "how-to" guides for the use of designers and operators of NYC-2 programs at the local level. The monographs serve to assist optimal application of new Labor Department standards and guidelines for the out-of-school NYC program. The monographs are concerned with the following four areas: (1) integrating remedial education into Neighborhood Youth Corps training programs; (2) criteria for the selection and training of Neighborhood Youth Corps work supervisors; (3) new directions in the vocational counseling of Neighborhood Youth Corps trainees; and (4) utilization of industrial advisory committees to increase employment opportunities. (DLMA abstract)

Descriptors: (*Education, Project planning), (*English language, Upgrading), (*Arithmetic, Improvement), (*Projects, Evaluation), Reading, Problem solving, Attitudes, Motivation, Instructors, Employment, Personnel development

Identifiers: *Neighborhood Youth Corps, *Disadvantaged youth, Voluntary attendance, *Remedial education, Spelling

PB-199 437 NTIS Prices: PC$3.00 MF$0.95

DISADVANTAGED YOUTH APPROACHING THE WORLD OF WORK: A STUDY OF NYC ENROLLEES IN NEW YORK CITY

Wakoff Research Center, Staten Island, N.Y. (367 875)

Final Report

Author: Mandell, Wallace; Blackman, Sheldon; Sullivan, Clyde E.

7273E2 FLD: 5C, 5K, 942 USGRDR7006

Nov 69 234p.*

Contract: DL-41-7-009-34

Abstract: The central question of the research was concerned with the degree to which NYC enrollees, NYC personnel, and potential employers shared a common frame of reference, and held similar views regarding the transactions involved in entering the world of work. This was studied by an examination of the congruence in work related perceptions of NYC enrollees, their work experience supervisors, and employers. The negotiating process itself during the employment interview was studied. Data regarding this bargaining session were gathered to include five major components. (Author)

Descriptors: (*Adolescents, Employment), (*Manpower studies, *New York), Economics, Sociometrics, Management planning, Data processing systems, Analysis of variance, Organizations, Federal budgets, Standards, Attitudes, Behavior, Questionnaires, Training

Identifiers: Disadvantaged groups, *Neighborhood Youth Corps, Evaluation, Ghettos, New York City (New York), Recommendations

PB-189 015 CFSTI Prices: HC$6.00 MF$0.95

METHODS IN THE EVALUATION OF PROGRAMS FOR POOR YOUTH

National Opinion Research Center, Chicago, Ill.

Author: Underhill, Ralph

6631H1 FLD: 5I, 5J, 942, 907 USGRDR6921

Jun 68 107p.*

Contract: OEO-1416

Abstract: The report covers the second and final phase of a pilot study of poor youth. The study has two immediate objectives: first, to provide a firm methodological basis for a subsequent large-scale evaluation of federal antipoverty programs aimed at young people and, second, to gather substantive information on the young people who are the target population for the Job Corps, the Neighborhood Youth Corps, and the Manpower Development and Training Act programs. The ultimate objective is a larger study of program effectiveness. (Author)

Descriptors: (*Adolescents, Retraining), (*Organizations, Effectiveness), Federal budgets, Reviews, Statistical data, Factor analysis, Problem solving, Employment, Motivation, Attitudes, Education, Correlation techniques

Identifiers: Poverty, Job Corps, Youth program evaluation, Neighborhood Youth Corps, Interviews

PB-185 786 CFSTI Prices: HC$6.00 MF$0.95

EVALUATIONS OF THE WAR ON POVERTY: THE FEASIBILITY OF BENEFIT-COST ANALYSIS FOR MANPOWER PROGRAMS

Resource Management Corp., Bethesda, Md.

6044J3 FLD: 5I, 5C, 5A USGRDR6912

Mar 69 167p.*

Report No.: RMC-UR-054

Contract: GA-654

Abstract: The document investigates the feasibility of applying benefit-cost analysis to anti-poverty programs and to demonstrate the strengths and weaknesses of that technique through application to specific programs. The relevance of such a study derives from the increased pressures on government agencies to justify their programs and the increased use of benefit-cost analysis for this purpose. The paper presents the results of an attempt to evaluate the Neighborhood Youth Corps-Out of School and Job Corps programs through a benefit-cost analysis. (Author)

Descriptors: (*Federal budgets, Manpower studies), Management planning, Cost effectiveness, Feasibility studies, Training, Regression analysis, Statistical data, Correlation techniques, Wages, Employment, Classification, Sex, Predictions

Identifiers: Ethnic groups, Evaluation, Benefit cost analysis, Poverty, Neighborhood Youth Corps, Job Corps

PB-183 305 CFSTI Prices: PC$6.00 MF$0.95

AN ASSESSMENT OF THE IN-PUBLIC SCHOOL NEIGHBORHOOD YOUTH CORPS PROJECTS IN CINCINNATI AND DETROIT, WITH SPECIAL REFERENCE TO SUMMER-ONLY AND YEAR-ROUND ENROLLEES

National Analysts, Inc., Philadelphia, Pa.

Final Report

Author: Robin, Gerald D.

5983F3 FLD: 5K USGRDR6911

Feb 69 338p.

Contract: DL-81-40-66-18

See also Supplement, PB-183 082

Abstract: The data were obtained in interviews conducted longitudinally with three analytically distinct groups of Negro youths: summer-only enrollees, year-round enrollees and controls. The first group consisted of students whose exposure to the program was limited to the summer period of 1966, at the end of which all such youths were terminated from their first contact with the program. The year-round enrollees consisted of a sample of participants who were active in the program at the time of sample selection-youths who had been working in the NYC during the regular school year and who were also given the opportunity to continue in the program in the summer of 1966 and thereafter. The controls were applicants to the NYC who were not admitted to the program. (Author)

Descriptors: (*Adolescents, Retraining), (*Employment, *Urban planning), Manpower studies, Statistical data, Classification, Interactions, Education, Attitudes, Wages, Motivation, Behavior, Delinquency, Time, Ohio, Michigan

Identifiers: Negroes, *Neighborhood Youth Corps, Interviews, Evaluation, Cincinnati (Ohio), Detroit (Michigan)

PB-183 081 CFSTI Prices: PC$6.00 MF$0.95

A COMPREHENSIVE ASSESSMENT OF THE PROBLEMS AND CHARACTERISTICS OF THE NEIGHBORHOOD YOUTH CORPS ENROLLEES: A PILOT INVESTIGATION

Research Triangle Inst., Durham, N.C. Statistics Research Div. (402 076)

Final Report

Author: Eckerman, William C.; Gerstel, Eva K.; Williams, Richard H.

5975G4 FLD: 5I, 5K USGRDR6911

1 Mar 69 433p.*

Report No.: RTI-SU-293

Contract: DL-81-35-67-01

Abstract: The overall objective of the research is to make a comprehensive assessment of the programs, characteristics and potentials of Neighborhood Youth Corps (NYC) enrollees in the state of North Carolina. Specific objectives of the study are to develop a methodology to identify and assess the magnitude of problems faced by NYC enrollees, to establish a scheme for classifying enrollees according to identifiable problem areas, and to formulate and examine a set of hypotheses related to these problems. An additional product sought in this research is a sound procedure for the collection and analysis of information necessary for the development of adequate manpower development programs. (Author)

Descriptors: (*Adolescents, Employment), (*Manpower, Training), Manpower studies, Management engineering, Leadership, Psychometrics, Problem solving, North Carolina

Identifiers: Neighborhood Youth Corps, Disadvantaged groups, Pilot studies

PB-183 080 CFSTI Prices: PC$6.00 MF$0.95

EVALUATION OF NEIGHBORHOOD YOUTH CORPS PROJECTS

Dunlap and Associates, Inc., Darien, Conn. (118 620)

Final Report

Author: Teal, Gilbert F.

5501H3 FLD: 5I USGRDR6904

Feb 66 176p.

Contract: OEO-916

Abstract: The objective of this research was to collect and analyze information relating to the effectiveness of the Neighborhood Youth Corps program. A sample of 15 in-school and 15 out-of-school programs was selected for review. Field visits were made to the 30 programs selected during the period from 5 January 1966 through 24 January 1966. (Author)

Descriptors: (*Employment, Adolescents), (*Adolescents, *Training), Statistical analysis, Economics, Labor, Education, Questionnaires, Attitudes, Delinquency

Identifiers: Evaluation, *Youth corps projects, Community work training programs, School-dropouts, Underprivileged

PB-180 546 CFSTI Prices: PC$6.00 MF$0.95

EVALUATION OF "PROJECT 44"—THE JOB CORPS CAPITAL CENTER
American Institutes for Research, Silver Spring, Md. International Research Inst.
Final Report
Author: Gloege, William P.
5441H2 FLD: 5I USGRDR6903
1966 40p.
Report No.: AIR-E98-10/66-FR
Contract: OEO-950
Abstract: The purpose of this study was to evaluate the impact of the Capital Center program on the behavior and attitudes of participating Job Corpsmen. (Author)
Descriptors: (*Adolescents, Retraining), (*Organizations, Effectiveness), Programmed instruction, Supervisory personnel, Students, Job analysis, Attitudes, Behavior, Records, Analysis, Impact, Motivation, District of Columbia
Identifiers: Interviews, Job Corps, Evaluation, Objectives
PB-180 307 CFSTI Prices: PC$6.00 MF$0.95

QUALITATIVE ASSESSMENT OF FACTORS AFFECTING RETENTION RATE IN JOB CORPS
Yankelovich (Daniel), Inc., New York
Final Report
5383L2 FLD: 5I, 5J USGRDR6902
Dec 67 131p.*
Contract: OEO-4092
Abstract: This report presents the findings and implications of a qualitative study of Job Corps. Specifically, the objective of this research was to determine causative factors in dropout on which practical and swift remedial action is possible and to suggest what such action might be. (Author)
Descriptors: (*Employment, Adolescents), (*Retraining, Attrition), Retention, Group dynamics, Behavior, Motivation, Attitudes, Applied psychology, Statistical data, Research program administration, Management engineering, Personality
Identifiers: Dropouts, Remedial action, Interviews
PB-180 219 CFSTI Prices: PC$6.00 MF$0.95

JOURNAL ARTICLES

EJ103546 AA519116

EXTENDED EDUCATION IN JUNIOR HIGH SCHOOL

Gregory, Kay Momentum; 5; 3; 13-7 Oct 74

Descriptors - *Extension Education/*Junior High Schools/*Program Evaluation/*Career Education/*Work Experience/Student Placement

Described a pioneer program in which junior high school students got a taste of the real work would via a unique career education program at St. Agnes Catholic School in Chicago Heights. (Author/RK)

EJ094209 CE500758

WELL-TRAINED DE STUDENTS CAN COPE

Domian, Judi American Vocational Journal; 49; 3; 45-7 Mar 74

Descriptors - *Distributive Education/*Program Evaluation/*Follow-up Studies/*Educational Experience/*Work Experience/Vocational Education/Success Factors

Questionnaire responses from graduates of the distributive education program at Fox High School, Arnold, Missouri, indicate that the program, which emphasizes especially supervision and club activities, has succeeded in equipping students with the skills, qualities, and experience necessary to take advantage of the opportunities available to them. (SA)

EJ091545 JC500652

APPRENTICESHIP PROGRAM

Reitz, Richard C. Community and Junior College Journal; 44; 5; 41 Feb 74

Descriptors - *Cooperative Programs/*Community Colleges/*Apprenticeships/*Program Evaluation/*Educational Experiments/Student Enrollment/School Community Relationship/Vocational Development/Higher Education

Describes an experiment in career training that helped to develop plant maintenance mechanics. (RK)

EJ085427 UD502586

CAREER EDUCATION: A MERGING OF ACADEMISM AND VOCATIONALISM?

Black Collegian; 4; 1; 10-11, 49 Sep-Oct 73

Descriptors - *Career Education/*Program Descriptions/*Cooperative Education/*Occupational

Guidance/*Program Evaluation/Disadvantaged Youth/Economically Disadvantaged/Handicapped Students/In-service Teacher Education/Educational Change

The Center for Vocational Education reviewed 26 career education programs in operation in various sections of the U.S., finding seven components common to most of them: cooperative education, career guidance, placement, follow-up, programs for disadvantaged and/or handicapped youth, and in-service teacher education. (JM)

EJ083270 SE509125

ASSESSMENT OF INDUSTRIAL TRAINING

Thomson, R. A. M. Education in Chemistry; 10; 4; 138-139 Jul 73

Descriptors - *Chemistry/*Cooperative Education/*Evaluation Criteria/*Evaluation Techniques/*Technology/Academic Performance/College Science/School Industry Relationship/Science Education

Identifiers - England

Discusses practical problems encountered in evaluation of industrial training contributions to student performance in cooperative programs. Concludes that a nationwide assessment scheme is needed to reach a higher validity. (CC)

EJ061777 VT504011

A FRAMEWORK FOR CAREER EDUCATION

Drawbaugh, Charles C. Journal of the American Association of Teacher Educators in Agriculture; 13; 2; 16-24 Jul 72

Descriptors - *Career Education/*Cooperative Education/Learning Characteristics/Occupational Guidance/*Program Effectiveness/*Program Evaluation/*Relevance (Education)/Teacher Education

EJ060153 VT503768

CHALLENGE TO EDUCATION

Ginzberg, Eli Thrust for Education Leadership; 1; 5; 6-8 Apr 72

Descriptors - *Advisory Committees/*Career Education/*Career Planning/*Educational Problems/Integrated Curriculum/Manpower Development/Manpower Needs/*Work Experience Programs

Contains responses of the National Manpower Advisory Committee to the career education concept, which raised several caveats, more as constructive criticism than in opposition to the concept. (Author/SB)

EJ060005 AC502006

THE ROLE OF TRAINING IN NATIONAL MANPOWER POLICY

Ginzberg, Eli Training and Development Journal; 26; 7; 30-4 Jul 72

Descriptors - *Manpower Development/*Manpower Needs/*Manpower Utilization/*Policy/*Training

EJ057422 AC501842

THE FUTURE OF THE INTEGRATED SANDWICH COURSE

Rankin, John Industrial Training International; 7; 2; 60-2 Feb 72

Descriptors - Academic Performance/College Curriculum/Cooperative Programs/Educational Innovation/*Evaluation Criteria/*Field Experience Programs/*Industrial Training/*Program Evaluation/*Student Evaluation/Teacher Attitudes

Sandwich courses' survival depends on devising a procedure to assess industrial training meaningfully. The author proposes a list of specific procedures in such an assessment, including regular student interviews with an assessment panel consisting of both his academic and industrial teachers. (Author/JB)

EJ039163 VT502519

JOB CORPS: THE URBAN CENTER AS A TRAINING FACILITY

Rawlins, V. Lane Journal of Human Resources; 6; 2; 221-235 Spr 71

Descriptors - *Adult Vocational Education/*Disadvantaged Youth/*Federal Programs/Poverty Programs/*Program Evaluation/Vocational Training Centers

Identifiers - *Job Corps

Despite high costs, this program is worthwhile because of its impact on post-training earnings. (BH)

EJ038095 AC501179

THE HAWKESBURY "ON-THE-JOB-TRAINING" PILOT PROJECT

Collins, Robert C. Canadian Training Methods; 4; 1; 20-22 Mar-Apr 71

Descriptors - *Community Cooperation/*On-the-Job Training/*Program Evaluation/*Rural Areas

EJ015826 VT501195

YOUTH CORPS PAY WHERE IT GOES

Bedell, Mary S. Manpower; 2; 2; 29-31 70 Feb

Descriptors - *Evaluation/*Federal Programs/*High School Students/*Income

Identifiers - *Neighborhood Youth Corps/NYC

Report on the uses made by disadvantaged youth of wages received from Neighborhood Youth Corps jobs. (BC)

PROJECTS IN PROGRESS

VTP 1676
Title: The Transition from School to Work: A Study of Laws, Regulations and Practices Restricting Work Experience and Employment Opportunities for Youth.

Initiator: Eli Cohen and Don Zimmerman
Institution: National Committee on Employment of Youth, New York, New York
Sponsor: U.S. Office of Education, Washington, D.C. Bureau of Occupational and Adult Education
Duration: June 1974 to February 28, 1975

Objectives: (1) To examine in depth the impact of laws, regulations and practices affecting the labor and education of youth—at the federal, state, and local level; (2) To examine non-agricultural employment in both the public and private sector; (3) To determine, where the legislature regulation, policies are found to be restrictive of job opportunities; and (4) To determine, where statutory requirements are found to be non-restructive, what other factors operate to limit opportunities.
Methodology: The study will be conducted in a representative sample of approximately six local labor market areas. What will be looked at are those states which have relaxed child labor legislation to determine whether the changes contributed to increased employment and work experience opportunities. However, more than the laws and regulations governing the work place, will be studied. The opportunities for work experience programs of all types, particularly those related to educational purposes and involving arrangements with employers which are affected by education laws, regulations and practices as well as by child labor legislation.

VTP 1671
Title: A Study of the Feasibility of a Cooperative Education Program and Formulation of a Plan of Action for Implementation at Chadron State College.

Initiator: No data
Institution: Chadron State College, Chadron, Nebraska
Sponsor: U.S. Office of Education, Washington, D.C. Bureau of Occupational and Adult Education
Duration: June 1, 1974 to March 31, 1975

Objectives: (1) To determine the feasibility of establishing a cooperative education program for Chadron State College students in western Nebraska; (2) To identify the opportunities for placing students in cooperative work experience positions; (3) To determine the most desirable model for

cooperative education in this area of Nebraska; (4) To lend support and possibly improve the quality of management of the small businesses in the area by infusing new ideas and methods from interns; (5) To provide some financial assistance to participating students through obtaining part-time positions on some arranged basis; and (6) To lend relevance to the curriculum and to provide an opportunity for updating the curriculum in vocational areas.
Methodology: The first step will be to identify and analyze cooperative education programs now operating in colleges similar to Chadron State College so that a composite model can be prepared from which to work. The second step will be to determine the feasibility of implementing the model in western Nebraska. The final phase of the project will be to write a proposed plan of action for implementing a cooperative education program in western Nebraska.

VTP 1670
Title: Guidance-Oriented Alternative Work Experience Program and Follow-Up Study.

Initiator: E. M. White
Institution: Caldwell County Board of Education, Lenoir, North Carolina
Sponsor: U.S. Office of Education, Washington, D.C. Bureau of Occupational and Adult Education
Duration: July 1, 1974 to December 31, 1975

Objectives: To design, develop, and field test a guidance oriented work experience program.
Methodology: The project will be designed to utilize the best guidance, counseling, placement, and student follow-up services in conjunction with training methods for students that are designed to develop skills useable by business and industry. Personnel from business and industry will be actively involved in determining and designing the necessary skills for the prospective employees. A third-party evaluation will be conducted of the project in order to determine the success of fusing academic, training, guidance and counseling, and work experience into a tightly knit program for students.

VTP 1669
Title: Competency Based Work Experience/Exploration Contract Programs.

Initiator: Robert A. Sampieri
Institution: Los Angeles Unified School District, California
Sponsor: U.S. Office of Education, Washington, D.C. Bureau of Occupational and Adult Education
Duration: July 1, 1974 to June 30, 1975

Objectives: (1) To conceptualize various work experience approaches for secondary students, (2) To obtain data which identifies the most important influences that determine the students' work experience satisfaction, (3) To identify various implementation and operational factors, (4) To delineate acceptable educational standards for work experience opportunities, and (5) To develop cost models for each major work experience configuration.

Methodology: The planned approach is an implementation and operational event in five major phases: (a) Planning, (b) Work Experience Specification Development, (c) Procedures Development, (d) Operations, (e) Evaluation. A Final Project Report will include, but not limited to, the identification: (a) A program analysis section, (b) An employer analysis section, (c) A study analysis section. The primary result of this study will be to develop a systematic contractual means of providing career education work experiences for secondary students which is both educationally sound and mutually beneficial to the contracting parties.

VTP 1668
Title: Decision Orientated Evaluation System for Alternative Work Experience Programs.

Initiator: Alfred Pavlish
Institution: School District of the City of Pontiac, Michigan
Sponsor: U.S. Office of Education, Washington, D.C. Bureau of Occupational and Adult Education
Duration: June 1, 1974 to November 30, 1975

Objectives: (1) To identify those aspects of alternative work experience programs which produce positive approaches with business, industry, and community organizations; (2) To determine methods for improving student and employer satisfaction in work experience programs; (3) To clarify legal and other barriers to work experience programs; (4) To use evaluation evidence to make decisions on standards for alternative work experience programs; and (5) To determine program costs on a per student basis and compare program costs in terms of student outcomes.
Methodology: Educate research team in the use of a formative/summative evaluation through contractual arrangements. Design formative evaluation documents by the research team. The data collected through the use of the documents will reflect the four factors of a modified Context, Input, Process, Product (CIPP) evaluation model. Examine existing programs to identify placement stations. Develop a pilot test questionnaire, administer and determine through analysis which placement method yields high student/employer satisfaction score. Find the problems with the laws in relation to student outcomes. Define cost factors in terms of input and process factors.

VTP 1667
Title: An Experimental Study of the Effects of an Alternative Work Experience Program in the Middle School.

Initiator: Norman D. Ehresman
Institution: Western Kentucky University, Bowling Green, Kentucky
Sponsor: U.S. Office of Education, Washington, D.C. Bureau of Occupational and Adult Education
Duration: June 30, 1974 to August 30, 1975

Objectives: (1) To provide information and procedures for the development and improvement of work experience programs, and (2) To ascertain whether or not a "real life," hands-on, work experience program for middle school students has a positive effect on students.

Methodology: The general design of this project is to establish an alternative work experience program to be used as the experimental variable in the research project. The project will be conducted in three phases: Phase I, To develop procedures for selection of students, placement, procedures, training of training sponsors (employers), development and evaluation of training agreements, training plans and research instruments; Phase II, The actual experiment will be conducted. The sample for Phase II will comprise 240 randomly selected and assigned ninth grade students. The 240 students will be assigned to an experimental group (n=120) and a control group (n=120). The experimental group will be given the treatment of participation in an alternative work experience program. The control group will not be given the treatment. Both groups will be pre-posttested; Phase III, Will be concerned with the analysis of data and preparation of the final report.

VTP 1666
Title: Cost-Effectiveness Study of Work Experience Programs.

Initiator: Elchanan Cohn and Morgan V. Lewis
Institution: Pennsylvania State University, University Park
Sponsor: U.S. Office of Education, Washington, D.C. Bureau of Occupational and Adult Education
Duration: June 30, 1974 to December 31, 1975

Objectives: (1) To examine the costs and benefits of alternative work experience programs, (2) To compare the various work experience programs relative to one another as well as to a control group of secondary students not enrolled in any work experience programs, and (3) To extend the scope of the cost-effectiveness methodology by broadening the cost and effectiveness dimensions.
Methodology: Seven categories of costs would be included in the cost estimates: salaries of instructional personnel, instructional costs excluding salaries, fixed charges, equipment maintenance and repair, other direct costs, amortization costs for buildings, and amortization costs for equipment. The total program costs would be adjusted to account for variations in such relevant factors as the quality of the program and the costs of inputs in the locality. The effectiveness criteria used include the following: employment experience following graduation, hourly wage rates and annual earnings, relatedness of job to training, post-secondary education, job satisfaction, general well-being, attitudes toward and satisfaction from vocational curriculum, success of the programs in retaining potential dropouts, and educational outcomes. The effectiveness measures, in turn, would be adjusted to account for differences in socioeconomic status, location of residence, race, sex, marital status, intelligence, etc.

VTP 1662
Title: A Study of Structured and Non-Structured Work Experience Programs in Texas.

Initiator: Gerald D. Gutcher
Institution: Texas A&M University, College Station
Sponsor: U.S. Office of Education, Washington, D.C. Bureau of Occupational and Adult Education
Duration: June 30, 1974 to December 31, 1975

Objectives: (1) To provide an impetus and incentive for community colleges to become more active in cooperative education programs, (2) To prepare guidelines for developing structured work experience programs, (3) To structure programs for the initial phases of work experience in approximately five occupational areas, and (4) To clarify the relative benefits that might accrue to students enrolled in either a traditional vocational-technical cooperative program or a structured work experience program.
Methodology: A pre-test and post-test control group design has been chosen for this project. Thirty-two students will be selected from community colleges in Texas offering vocational-technical instruction. Random and equal assignment to control and experimental groups will be made so that each group contains twenty-five subjects. Subjects assigned to the experimental group will be placed in industrial training stations where the employer has agreed to follow the structure and schedule as established for that occuaption. The control group subjects will be placed in training stations where no attempt will be made to alter or modify the learning procedure from that which is normally followed.

VTP 1661
Title: Alternative Work Experience Programs.

Initiator: Ray Karnes
Institution: University of Southern Mississippi, Hattiesburg, Mississippi
Sponsor: U.S. Office of Education, Washington, D.C. Bureau of Occupational and Adult Education
Duration: June 1, 1974 to November 30, 1975

Objectives: (1) To identify and describe the more creative but feasible work experience alternatives toward which business, industry, labor, community and civic organizations, school personnel, school boards, parents and students may be favorably disposed; (2) To establish a basis for and prepare guidelines to facilitate a higher order of student and employer satisfaction in work experience programs; (3) To analyze and clarify the legal, social, economic, employer, labor, parental, educational and travel barriers to work experience programs, and formulate plans for offsetting these barriers; (4) To develop guidelines which include suggested standards for work experience programs; and (5) To assess the project costs and cost-benefits for each of the alternative work experience programs identified.
Methodology: The project staff will establish an advisory council whose competencies will enable them to contribute to the project. The council members and staff will select the geographic area(s) within which data will be collected and the feasibility of alternate plans for work experience programs will be field tested. Facts about the area will be compiled and analyzed; instruments will be prepared identifying the number and types of employment situations in the area(s) which offer opportunities. To obtain assessments of the level of support anticipated from employers, community group, school personnel, parents and students, structured interviews will be the primary procedure.

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DESCRIPTOR: *ADVISORY COMMITTEES; *AGRICULTURAL EDUCATION; *COMMUNITY INVOLVEMENT

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ABSTRACT: BASED ON THE BOOK "ORGANIZING AND USING AN ADVISORY COUNCIL" BY CLAUDE E. RICHARD (JANUARY 1965) THIS PUBLICATION EXPLAINS THE FUNCTIONS OF ADVISORY COUNCILS AS RELATED TO LOCAL DEPARTMENTS OF AGRICULTURAL EDUCATION. THE PRIMARY PURPOSE OF AN ADVISORY COUNCIL IS TO ASSIST AND ADVISE TEACHERS AND ADMINISTRATORS IN PLANNING, ORGANIZING, AND CONDUCTING AN INSTRUCTIONAL PROGRAM IN AGRICULTURAL EDUCATION THAT WILL EFFECTIVELY MEET THE EDUCATIONAL NEEDS OF THE PEOPLE IN THE COMMUNITY. METHODS OF PLANNING, SELECTING, ORGANIZING, AND STARTING AN ADVISORY COUNCIL ARE SUGGESTED AS WELL AS ACTIVITIES FOR THE COUNCIL AND WAYS TO MAINTAIN IT. REFERENCES ON ADVISORY COUNCILS ARE PROVIDED AND SAMPLES OF A CONSTITUTION AND BY-LAWS FOR AN AGRICULTURAL ADVISORY COUNCIL, AN INFORMATION SHEET FOR A NEW COUNCIL MEMBER, AND AN OUTLINE FOR A HANDBOOK FOR COMMITTEE MEMBERS ARE APPENDED. (LJ)

INSTITUTION NAME: VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. AGRICULTURAL EDUCATION PROGRAM.; VIRGINIA STATE DEPT. OF EDUCATION, RICHMOND. AGRICULTURAL EDUCATION SERVICE.

102 568

ORGANIZING AND USING
an
ADVISORY COUNCIL

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2

ORGANIZING AND USING
AN
ADVISORY COUNCIL

Prepared by
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In Cooperation with
Agricultural Education Service
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Richmond, Virginia 23216

1975

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ORGANIZING AND USING AN ADVISORY COUNCIL

I. Introduction

The local department of Agricultural Education has the responsibility for the agricultural and leadership training of the people of the community who are at present, and who contemplate being engaged in the field of agriculture. The teacher of agriculture is charged with the responsibility of developing and carrying out a program of instruction that is adapted to the agricultural needs and opportunities found in the particular community in which he works. Even the most capable and energetic teacher needs the assistance and support of the most capable leadership in the community in developing and executing a complete, well-rounded instructional program in Agricultural Education. To make educational programs democratic in nature, the people who are affected by a program should have a part in its planning and execution.

The Annual and Long-Range Improvement Plan for the Agricultural Education Service outlines the following objectives related to advisory councils:

5.5 By June 30, 1980, all school divisions with agricultural education programs will have organized local advisory committess in accordance with the local 5-year plan of Vocational Education.

5.5.1 By October 1, 1975, material on Agricultural Education advisory committees will be provided all school divisions.

5.5.2 By January 15, 1976, the local school divisions 5-year plans for Vocational Education will include a section dealing with the organization and operation of the local agricultural education advisory committee.

5.5.3 By March 1, 1976, updated materials on the organization and utilization of advisory councils for Agricultural Education will be prepared for dissemination to Agricultural Education teachers by the teacher education staff.

5.5.4 By September 1, 1976, the Agricultural Education service will, as a part of their summer teachers conference, include in-service activities centered around the utilization of advisory committees.

"An advisory council, beginning with the passage of the Smith-Hughes Act in 1917, has continuously been a desirable feature of the program of agricultural education but never a necessary feature (5:1)." This situation can now be ameliorated. With the above objectives for the Standards of Quality, increased emphasis will be placed on advisory councils by all concerned with Agricultural Education.

Since all of the people in a community affected by the Agricultural Education program cannot logically take part in its planning, then they should be represented by someone who shares and understands their interest and needs. Advisory councils made up of persons who represent the school and agricultural interests of the community have provided a solution, in many communities, to the needs of the teacher and department in planning and conducting an effective program of Agricultural Education.

Definitions. "Citizen groups discussed in this paper may be defined as lay citizens without legal authority who advise a governing body regarding policy and/or who advise a professional staff regarding program and procedures (10:5)."

". . . A group of persons outside the education profession chosen from the community, state, or nation to advise educators regarding an educational program. The advisory committee is usually a formally organized committee appointed by proper authority or authorities for a definite time (2:1). The terms "advisory" and "consultive", "committee" and "council" are often used interchangeably with reference to this activity and function (2:2)."

Types of Councils. The types of advisory councils can generally be classified as general, local option and ad hoc, although many other titles are often assigned to them.

The general advisory council can be viewed from two frames of reference in Agricultural Education. The general advisory council might serve all of vocational education as illustrated in Figure 2 for a large school. It might also serve as an "occupational committee" in a small school system to advise only the Agricultural Education department. General advisory councils may exist on the State and National level to advise all of Vocational Education and Agricultural Education.

The local option committee, a term often used by Dr. A. H. Krebs, would serve the purpose of a "specific consulting committee" as shown in Figure 2. A local option committee would certainly be recommended for departments with several options offered. Under this arrangement, an Agricultural Education department might have a General Advisory Committee and the options might have "option committees", as illustrated in Figure 3. An option committee might be called a craft committee by our friends in trade and industrial education. The purpose of the option committee would be to advise upon the specific Agricultural Education option.

Ad hoc committees meet and serve to advise upon a particular problem or task. They are traditionally dissolved once they have met their particular objective, or if need be they may form a permanent committee.

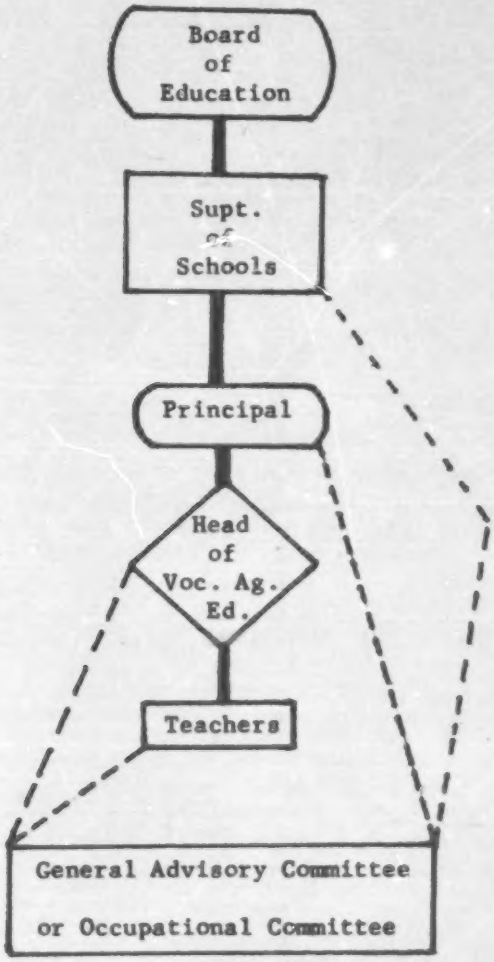
Another type of committee is commonly used when a new program or option is being planned. This is a special form of an ad hoc committee and is called a steering committee.

The aforementioned general agricultural advisory council might be comprised of the members of, or their elected representative, the option committees.

Figure 1

Organization Chart for Administration

of Voc. Ag. Ed. in Small School Systems

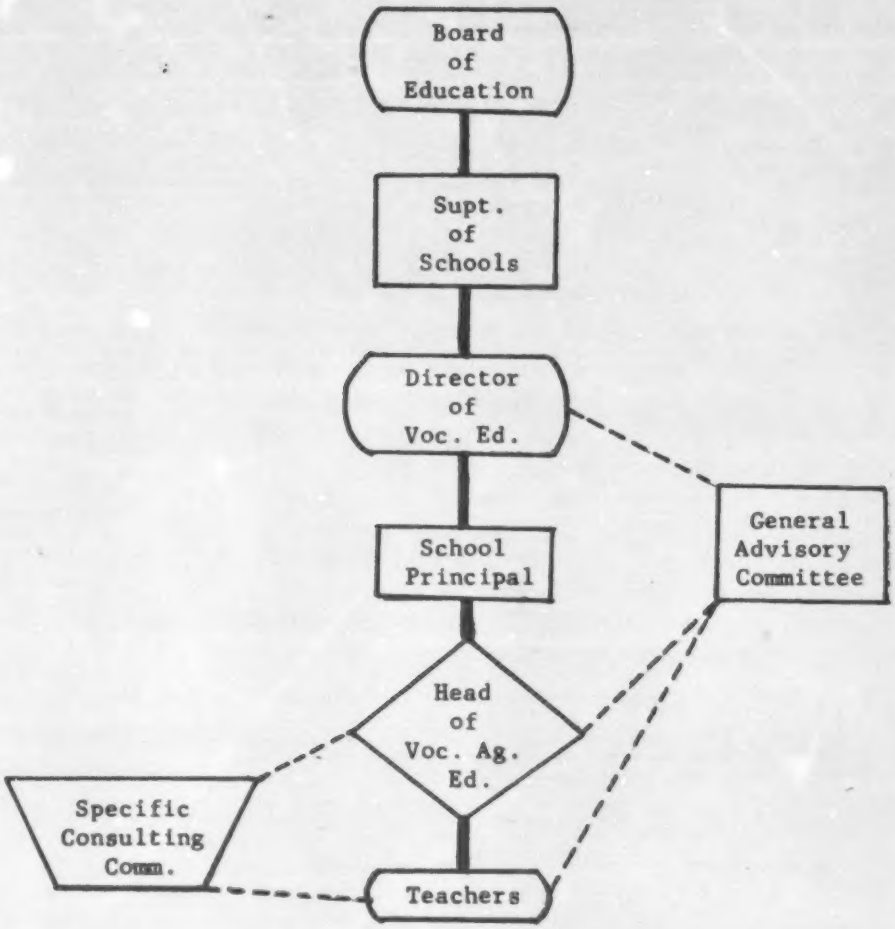


_____ ADMINISTRATIVE FUNCTION --------- ADVISORY FUNCTION

Figure 2

Organization Chart for Administration

of Voc. Ag. Ed. in Large School System



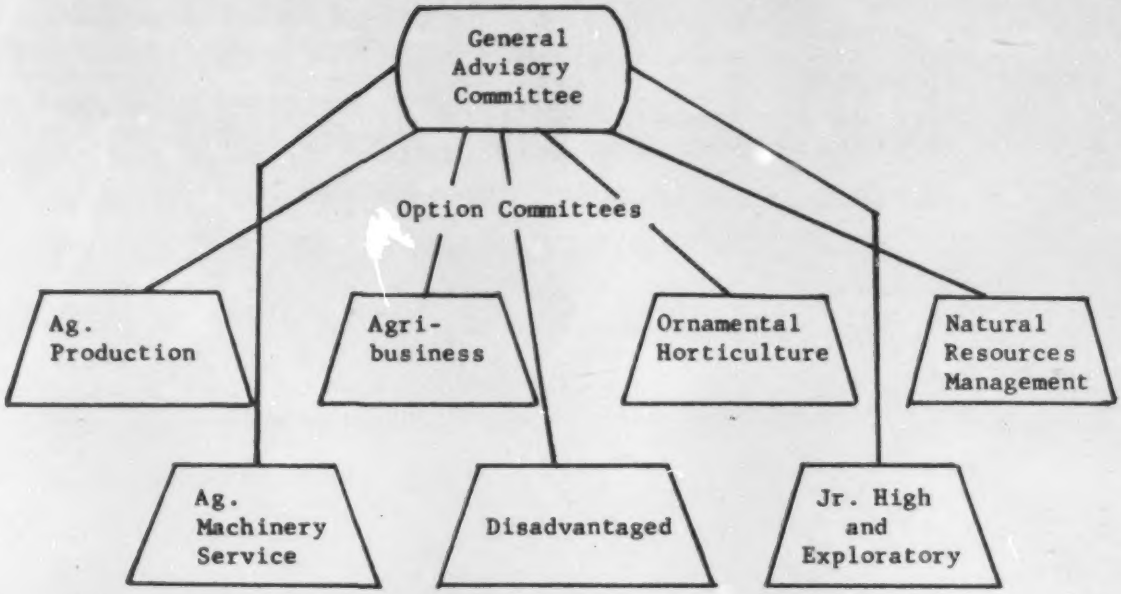
_____ ADMINISTRATIVE FUNCTION

------ ADVISORY FUNCTION

Figure 3

A. ricultural Education Department

..dvisory Council Organization



The following material is prepared to assist teachers of Agricultural Education in Virginia to organize and use advisory councils effectively in planning and conducting their programs of Agricultural Education.

II. Purposes of An Advisory Council

The primary purpose of an advisory council is to assist and advise the teacher and administration in planning, organizing, and conducting an instructional program in Agricultural Education that will effectively meet the educational needs of the people in the community.

In addition to the primary purpose there are many other purposes of an advisory council. Some of them are listed below. For a more complete list one should consult the references listed at the end of this publication.

A. An advisory council is a means for helping the teacher to mobilize the community leadership to aid with the agricultural training program.

B. To improve the public relations program by providing two-way communication between the department and the community.

C. Assist in the evaluation of the program, thus resulting in better objectives, improved program and more adequate facilities.

D. To guide and support the teacher, thus making it possible for him to be more effective, gain more satisfaction from his work, develop more confidence, and to advance more rapidly in his profession.

E. Assist in adjusting the program to changes, both gradual and emergencies, thus keeping it more up-to-date and desgined to serve the future rather than the past.

F. Assist the department and administration in developing policies for the operation of the department.

G. To insure the continuation and stabilization of the Agricultural Education department and its program where changes occur in either the instructional or administrative staffs.

H. To assist in clarifying and strengthening the relationships of the Agricultural Education department with the agricultural, business, commercial, civic and other organizations of the community.

I. To assist in determining the community agricultural training needs and job opportunities and facilities needed to meet these needs.

J. An advisory council provides recommendations and advises. They are not vested with the authority to make administrative decisions on policy (1:1).

III. Establishing the Council

The teacher must have a desire for and feel sure that he is willing to accept a council's suggestions, make maximum use of it and keep it functioning. He should also be conscious of the fact that only through a cooperative effort with the people can he have a successful program in vocational agriculture.

A. Preliminary Planning

1. The teacher should become thoroughly familiar with the purposes, procedures of organization, and the functions of a council before starting to organize.

2. The teacher should consult his school principal, superintendent and school board members to secure their approval and backing and inform them of the purposes and functions of a council.

3. The teacher, with the assistance of administrative officials, should develop a statement of policy regarding the activities of the council which is approved by the school board, to include such items as:
   a. The purpose of the council
   b. The duties of the council
   c. The area or field in which it operates
   d. The council's limitations
   e. The number to be selected
   f. Method to be used in selecting members
   g. The length of term for council members
   h. The relationship of the council to the teacher, department of Agricultural Education, and school administrators, including the school board.

   The council constitution (Appendix A) should reflect the local policy.

B. Selecting Council Members

1. After approval for the establishment of a council the teacher, together with the principal and superintendent selects and nominates the council members for approval by the school board. Only those members should be selected who are public spirited, interested in the welfare of all the people in the community and willing to devote adequate time to the council. A large number should be considered from which a definite number is selected.

2. The size of the council will depend somewhat upon the area served by the school, the number of communities and total population of the school area. In most communities from 9 to 12 members make the most efficient councils; while in county consolidated schools, a larger number would probably be more representative and desirable.

3. It is very important to have all of the agricultural interests in the community represented on the council, including the production, processing, marketing, supply, and service segments of the agricultural industry.

4. In selecting a representative council for a department, groups having such diversified agricultural interest as the following should be considered.

   a. Geographical location -- all parts of the community should be represented.
   b. Farmers who are representative of those agriculture commodities produced locally.
   c. Large and small farm operators, including part-time, share croppers, tenants and in some areas farm workers.
   d. Representatives of agricultural businesses.
   e. Professional and business persons serving the area who have an interest in agriculture.
   f. Members of farm organizations.
   g. All age groups above the high school level. Many of the best council members have been in the group between 25 to 35 years of age.
   h. Members of the young and adult farmer classes.
   i. Persons of different economic levels.
   j. Different religious, political and nationality groups should be recognized somewhat in proportion to their numbers in the community.
   k. Women should be considered.
   l. Parents of members of the high school vocational agriculture classes should be represented.

5. It should be noted that a council member may be a representative of two or more of the groups listed above. It should also be emphasized that a council member should not think of himself as representing a particular group, but instead be interested in the whole community.

6. Public officials such as school administrators and related agricultural agencies, should be invited to attend meetings of the council when their presence is believed necessary and valuable, but are not considered official members of the council. They may be designated ex-officio members. School officials are the recipients of the advice and should not have a vote in formulating the advice.

7. After members have been selected the superintendent should write each member and inform him that he has been selected, and ask him to serve.

8. After the superintendent has written the members, the teacher should visit each of them to find out if they will serve, make further explanations as needed and notify them of the first meeting date.

Krebs (11:4) outlines an alternative procedure by random selection. He recommends that a complete list of eligible members be developed, the list is stratified by agricultural interest area, determine the number to be selected from each area, number all people within each group consecutively, draw the nominees by random selection and select about twice as many as needed to allow flexibility in invitation by the School Board. The list should be kept in the order drawn in case someone needs to be replaced.

Appendix F may provide the reader with some insight into the expectations of a committee member.

C. Organizing and Starting The New Council

Getting a council started on the right track is most important. The first meeting of the council may make or break it. It is recommended that the division superintendent, the chairman of the school board, or the local school board member act as chairman of the first meeting, rather than the principal or teacher of agriculture. He should have a thorough understanding of what's to be done. The chairman should heartily welcome the selected members who are to serve and make them feel they are wanted and will play an important part in the functioning of the department. It is important that the principal of the school and all members of the council be present.

The main purpose of this meeting is to acquaint the members with their duties and responsibilities as council members and allow them an opportunity to ask questions and get straight any matters they may have regarding the council. It would probably be best not to organize at this first meeting, but give members a chance to think about whom they want for officers.

It is advisable to have an outsider who is familiar with advisory councils to come in and talk to the group the first night. An outsider can say things and get across what a local person cannot. Topics that should be thoroughly discussed during the orientation period of new councils are:

1. General purposes and policies of councils.

2. Desirable activities.

3. What other successful councils are doing.

4. How councils are organized.

5. Constitution and by-laws needed.

6. Frequency and place of meetings.

At the first meeting the members should decide how they want to organize, when they want to meet for the organizational meeting, appoint a nominating committee and possibly a committee to recommend when, where and how often to hold meetings. (See Krebs, 11:9-10, for agendas for meetings.)

At the second meeting they would elect officers, decide on when, where and how often to meet, appoint a constitution and by-laws committee and other business necessary to get straightened out on how to operate. Let the newly elected chairman take over as soon as elected. The Agricultural Education teacher should not serve as chairman.

During this meeting the members may desire more discussion on how an advisory council functions, its purposes and activities. As much time as is needed should be taken to thoroughly familiarize each member with the functions of a council.

If the organization and orientation has progressed satisfactorily to this point, it may be wise to select a timely and important topic for discussion. The discussion may be started at this meeting or decided upon for the next meeting.

A council should start off on a sound basis by considering worthwhile activities. The first year is the most important. Some of the important activities of a council the first year may be as follows:

1. Becoming familiar with the whole movement of Agricultural Education and its application locally.

2. Becoming familiar with legal and administrative policies of Agricultural Education departments.

3. Becoming familiar with the local department and its program. Study its objectives and accomplishments.

4. Becoming acquainted with the needs of the local community and community agricultural opportunities.

5. Review the local school objectives and policies.

6. Become familiar with vocational legislation and funding procedures.

7. See Appendix D for a Sample Meeting Agenda, and Appendix E for other meeting topics.

Other activities which should be considered in getting the council properly oriented and started are as follows:

1. Getting properly organized with adequate operating rules and regulations. Review a local handbook for committee members. See Appendix B for an outline and Appendix C for a sample handbook.

2. Becoming acquainted with the duties and responsibilities of council members.

3. Becoming acquainted with what other councils are doing.

4. Selecting activities on which the council wants to work and appoint committees for these activities.

5. Become acquainted with fellow council members and school staff.

Guidelines for Agenda Items. The following questions should be resolved in determining the appropriateness of an item for the agenda of the advisory council.

1. Is this a real problem?

2. Is this a problem the school really wants solved?

3. Will the school use the recommendation of the council?

4. Will the council be, or become, interested in the problem?

5. Is the council competent to consider and make recommendations on the problem?

6. Do members have sufficient knowledge of facts and background information to make worthwhile suggestions?

D. Officers

The council should have a chairman, vice-chairman, secretary, and one or two additional members to serve on the executive committee with the three elected officers. The chairman and vice-chairman should come from the regular members and not be a school administrative official nor the agriculture teacher. The agriculture teacher may serve as the secretary if the council so desires.

E. Rotating Members

Rotate membership on the council so that one-third of the members are replaced each year. Usually the original members are selected by lot for terms of 1, 2, and 3 years, and thereafter members are selected for a full three year term.

F. Constitution and By-laws (See sample in Appendix A)

1. What to include in the constitution:

a. Persons and agencies to whom the council is to advise
b. Purposes and duties
c. Number of members

d. Manner of selecting members
e. Length of term of members
f. Provision for eliminating inactive members
g. When a member can serve a second term on the council.
h. Representation of the school administrators at council meetings
i. Requirements of council minutes
j. Officers and committees and their duties

2. What to include in the by-laws:

a. Number and frequency of meetings
b. Length and time of meetings
c. Place of meetings
d. Method of calling special meetings
e. Method of notifying members of meetings
f. Preparation of the agenda for meetings
g. Special committees

G. Frequency of Meetings

The frequency of council meetings should be determined by the council. Most councils that are serious about their work will choose to meet at least bi-monthly or more often. A definite regular meeting date should be set, with special meetings called as needed. Unless a council meets regularly and rather frequently, interest will lag and little can be accomplished on important projects and undertakings.

IV. Suggested Activities of an Advisory Council

It would be impractical to attempt to list all of the activities in which an advisory council would be expected to participate. Activities of councils will vary with communities. Councils, under the leadership of the teacher of Agricultural Education, will determine their own activities suitable to their communities. Since councils are primarily interested in improving the educational program and activities of the Agricultural Education department some of the primary activities in which councils would be expected to participate are as follows:

A. Assist in determining the purposes of the Agricultural Education department, the area to be served, and the people to be reached in comparison the the people who are being reached.

B. Assist in determining community needs and advising on the type of educational program to be offered, including community services.

C. Determining the opportunities for agricultural employment in the community.

D. Assisting in planning and developing the program of work and teaching program to adequately meet the Agricultural Education needs of the community.

E. Advising and assisting in determining the need for and organizing young and adult farmer classes in the community.

F. Assuring the teacher as to the practicability of the program offered and, through this and other means, developing public confidence in the teacher.

G. Advising and assisting the teacher to develop and conduct a satisfactory public relations program.

H. Evaluating the program of the department and making recommendations for improvement.

Other activities in which the council may engage in advising and assisting the teacher in planning and conducting his program may be as follows:

A. Advising a new teacher about local customs, attitudes, community nationalities, and community events that might affect his adjustment in the community.

B. Advising and assisting when emergency situations arise so that the department may, more effectively meet the problems.

C. Assisting a new teacher to continue the program started by the previous teacher.

D. Assisting in unifying the activities of the program of Agricultural Education with the programs of the several groups and agencies in the school service area that are interested in agriculture and Agricultural Education.

E. Studying problems presented by the board of education on which further information and ideas are desired and then making recommendations.

F. Advising on supplies and equipment needed, such as reference books, laboratory supplies, farm mechanics equipment, and general supplies.

G. Visiting the supervised occupational experience programs being developed by the students and advising on the further improvement and expansion of these programs.

H. Learning the resources of the agricultural department, the sources of its funds and the uses which may be made of them, and the conditions under which it must work.

I. Advising on the program and activities of the local FFA Chapter.

V. Maintaining The Council

Maintaining a council is more important than establishing one. If a council is not maintained and used, it is better to have not started one in the first place.

A. Some reasons why councils fail:

1. They are not set up correctly in the first place.

2. Members have not been properly oriented and do not understand their duties.

3. They commonly die from inactivity. They are not kept busy or they have too little to do.

4. Meetings are not planned and they accomplish too little.

5. Meetings are held too infrequently. Little carryover from one meeting to another meeting takes place.

6. Teacher and administrators take too little interest in the council and fail to make adequate use of it.

B. Some suggestions for maintaining a council are:

1. Plan each meeting carefully. This should be done by the executive committee with the assistance of the teacher. Plan each meeting around one or more important phases of the program.

2. Keep council members busy on valuable projects. Smaller ad hoc committees may be appointed to work on special projects.

3. Keep all members informed of their duties, particularly the new members each year.

4. Stick to the rules and regulations which have been adopted by the council.

5. Teachers and administrators take an active interest in the council. They work with the council but do not dominate it.

6. Avoid domination by individual members.

7. Have regular scheduled meetings. Hold meetings frequently enough to carry out a good program.

8. Publicize council activities. Local newspaper articles on activities and achievements of the council are suggested.

9. Individual initiative and ideas of council members should be encouraged. Make members feel that their participation and contributions are important.

10. Keep a complete set of minutes and a record of all council activities and make them available to all council members.

11. Notify members of meetings and meeting topics.

12. Visit members regularly.

13. Hold meetings in the Agricultural Education department and not in the homes of members.

14. Review accomplishments at the end of the year.

15. Teachers or administrators should never attempt to speak for the council or to take action in their behalf without consulting them.

16. It is a voluntary organization and members should not be expected to carry-out long, detailed work assignments.

17. Do not conceal facts from the council.

C. Some things advisory councils should not do:

1. They should not put on drives for money.

2. They should not put pressure on the school board.

3. They should not start new organizations.

4. They should not meddle in general school affairs or try to establish policy.

5. They should not try to run the school.

VI. Conclusion

The advisory council, when carefully selected, properly organized, and tactfully used, should be of inestimable value to the teacher of Agricultural Education, his department, and to the community. The extent to which an advisory council functions depends upon the vision, initiative and tact of the teacher as well as the members of the council.

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Appendices

Appendix A

CONSTITUTION AND BY-LAWS
FOR THE AGRICULTURAL ADVISORY COUNCIL
OF _____ HIGH SCHOOL

Article I - Name

The name of the organization shall be the Agriculture Advisory Council of _____ High School.

Article II - Advisory to

Those people in charge of setting up and carrying out the activities of the Vocational Agriculture Department.

Article III - Area to Serve

Shall include all the service areas of the school.

Article IV - Purposes and Duties of Council

1. Help to develop and evaluate a course of study for high school classes.

2. In the development of the program of work and community activities of the FFA by suggesting areas that need emphasis, and activities that are appropriate to the community.

3. In the development of plans for Supervised Farm Practice with the high school class by reason of their intimate knowledge of individuals and situations in the community.

4. By helping with the placement of Vocational Agriculture students on farms for experience and by helping with the establishment of graduates in farming.

5. In the improvement of the physical plant for Vocational Agriculture because of their intimate knowledge of the needs of the department.

6. In field of public relations by interpreting and publicizing the program of Agricultural Education to people in the community, and by defining the job of the teacher of agriculture. Also by carrying pertinent information of the department to the community and by bringing information of the community to the department.

7. In establishing out-of-school classes, together with helping to work out courses of study recruiting members and evaluating the results of the program.

8. The council shall advise on all matters concerned with the Agriculture Department.

Article V - Number of Members

There shall be nine members on the council.

Article VI - Selecting and Replacing Members

Members shall be selected or replaced by drawing up a list of potential members as suggested by the present members.

The suggested list of potential members shall be submitted to the school administrator to submit to the board of education.

The board of education may as it so desires approve the suggested list or appoint any members they see fit to serve.

Article VII - Term of Members

Members of initial council shall draw for terms in one, two, and three year lots of three.

Members will be chosen such that one-third of the membership will leave the council each year.

Article VIII - Inactive Members

Members missing one-half or more of all meetings per year shall be eliminated from the council.

Final decision on eliminating inactive members is subject to majority vote of members present.

Article IX - Reappointment of Members

Members shall be eligible for reappointment to the council one year after expiration of former term.

Article X - Representation of School Administrators and Board of Education

Members of the school board of education and school administrators shall serve as ex-officio members.

The school administrators will be advised as to time and date of all meetings.

Article XI - Council Officers and Committees

There shall be a president whose duties will consist of calling meetings to order, carry out business of meetings, and appoint all committees.

There shall be a vice president who will preside at meetings when the president is absent.

The secretary will keep a record of the minutes of each meeting, carry on any correspondence of the council, and prepare an agenda for meetings of the council.

The council executive committee shall consist of the president, vice president, and secretary.

Article XII - Amendments

This constitution may be amended by a two-thirds vote of the membership present at a meeting.

By-laws may be adopted at any regular meeting by a two-thirds vote of the membership present at a meeting.

Article XIII - Voting

Ex-officio members shall not be eligible to vote. The agriculture teacher shall not be eligible to vote.

By-Laws

1. Stated Meetings -

   There shall be stated meetings one each calendar quarter.

2. Special meetings -

   Shall be subject to call by the president.

3. Time of meetings -

   During the first and fourth calendar quarters meetings will be held at 7 P. M. (EST).

   During the second and third calendar quarters meetings will be held at 8 P. M. (EST).

4. Length of meeting -

   Meetings should not exceed two hours.

5. Method of calling special meetings -

   The meetings will be called at the discretion of the executive board of the council.

6. Preparation of agenda -

   The secretary shall prepare an agenda before each meeting.

Appendix B

Sample Outline for a Handbook for Committee Members

I. Importance of Advisory Committees

II. Method of Selecting Members

III. Length of Term of Office and Plan for Rotation of Membership

IV. Functions of Advisory Committees

V. Objectives of the School

VI. School Policies

VII. Duties and Responsibilities of School Representatives

VIII. Brief Summary of Federal Acts for Vocational Education

IX. Basic Provisions of Ag. Ed. Section, State Plan for Vocational Education

X. Statement of Appreciation

Appendix C

Advisory Council Member[1]

You Are Now a Member of a Career Advisory Council

You have been asked to lend your capabilities, experience and knowledge as an ADVISOR to an agricultural education program in your school. Since you represent a segment of business and industry for which your school is educating students, you are valuable asset toward the proper preparation of these students who may be considering or actually entering the educational program of their choice.

Students, who eventually will work and live in the community, often must have serious consultation and career exposure in order to help choose a career. After making a choice, the student needs to learn enough to: (1) compete successfully in the job market; (2) find employment in the career specialty for which he is educated and to hold that employment; or (3) qualify for higher education in the career field of his or her choice. To provide the modern, up-to-date training for future citizens, your school needs your advice, assistance, and council.

What your ADVISORY COUNCIL will do and how effective it will be in developing a quality agricultural educational program depends upon the combination of your recommendations, the educational beliefs of your school, the adequacy of the instruction (including sufficient equipment and facilities), and the motivation of the individual student.

Why Have An Advisory Council?

An Advisory Council of interested, able and concerned citizens is the most productive and relevant method to involve the community in education. It is a vital link between the community and the school. It can give advice, make recommendations and provide service otherwise not available.

Why Get Involved?
Which of the Below is Important to You?

Recognizes your experience and knowledge in your business.

Provides the satisfaction of making your knowledge and expertise available to your community school.

Potential employment of students who can be a source of part-time employees for your business.

Provides a source of better trained and experienced future full-time employees.

Offers the satisfaction of being involved with the education of youth and adults of your community.

[1] Adapted from 3:1-6.

Gives you an investment in building leadership for the future "work force" of the community. This helps keep the community strong to protect the economic strength of your business.

Advisory Council

Definition

AN ADVISORY COUNCIL IS A GROUP OF PERSONS SELECTED TO COLLECTIVELY ADVISE REGARDING CAREER EDUCATION EFFORTS WITHIN THE COMMUNITY. MEMBERS ARE PREDOMINANTLY FROM OUTSIDE THE FIELD OF EDUCATION AND ARE SELECTED BECAUSE OF SPECIALIZED KNOWLEDGE.

Purpose

To collectively advise, make recommendations and give service to the school, its students, instructors and administrators.

How You Can Help

Advise on developing policy and local philosophy in regard to agricultural programs.

Help determine educational goals and requirements pertaining to the community in relation to each student.

Help establish and maintain good communication between the community and school.

Advise in developing the educational objectives for Agricultural Education.

Aid in evaluating the educational program or programs in respect to community requirements and individual career accomplishment of its graduates.

Advise the school administration relative to proper qualifications of instructors for certain specialized programs.

Aid in establishing criteria for selection of students.

Assist in long term planning for programs including curriculum, equipment and facilities.

Promote certain educational services to students and citizens such as career information, job placement, public relations, obtaining resource people for the classroom, etc.

Term of Membership

It is understood that individuals who serve on different ADVISORY COUNCILS often have busy schedules. On the other hand each member must realize that he or she must be willing to devote sufficient time to the council activities to be effective.

In order that membership may not become burdensome to any one member and so that other individuals who have expressed an interest in the educational program may have the opportunity to make a contribution, the suggested length of membership is three years.

It is suggested that the first advisory council members draw lots for one, two, or three year terms. Thus each year one-third of the membership will be replaced. This insures new members each year with varied experience and expertise and allows others in the community to make their contribution to the school educational program. At the same time, with two-thirds of the membership continuing, it allows for continuity in leadership and needed stability of the council operation. A person who has served a term as a member should be ineligible for reappointment until one year has elapsed following expiration of his term. Some valuable former members can be utilized as consultants for specific parts of the program but for a limited time only.

Advise and Recommendations
What Happens?

After the council secretary documents the council's recommendations, the School Representative then submits the request to proper authority for action. This could be the Superintendent of Schools. President of the Board of Education, Vocational Director or whomever has the authority to implement.

The recommendation is considered by the administrative authority or teacher and a report is returned to the chairman of the council by the education representative as soon as possible to the action taken or anticipated. There should be a minimum of delay for this report to be made.

One or more of three results should take place.

the recommendation is implemented as presented.

the recommendation is to be implemented with stated modifications, with explanations.

the recommendation is declined, with explanations.

Check List

What An Advisory Council Can Do

Help For Teachers and Administrators

Assisting school administrators and instructors in establishing a philosophy of Agricultural Education

Assisting in the preparation of measurable objectives for Agricultural Education

Maintaining all advisory council activity on an advisory status only, but at the same time realize the school needs your assistance to insure community relevance to local educational careers

Assisting in establishing Agricultural Education programs and advising on the use of proper criteria of evaluation

Extending your expertise for clinics, in-service workshops, seminars and training programs to school Agricultural Education faculty

Assisting in establishing teacher qualifications for specific occupation teaching

Identifying substitute or resouce instructors from the community to assist regular teachers in the classroom and/or teach in specialized program areas both day and evening.

Assisting in preparing job descriptions on which course content may be used.

Suggesting general occupational abilities necessary for a graduate of an occupational area to have in order to compete in the community job market

Providing criteria for awards and prizes to outstanding students

Identifying potential training stations for the placement of students in cooperative education programs

Arranging meetings to establish cooperative relationships between the schools and industry (also parents in high school or elementary schools)

Student Career Selection, Placement and Evaluation

Assisting in public relations procedures both externally and internally to encourage young people to consider vocational and technical education to include:

assisting in the formulation of a speaker's bureau to make speeches to civic clubs, career day meetings, etc.

assisting in establishment of procedures for approaching parents to provide vocational and/or technical information

providing ideas for taking steps to acquaint younger students and teachers in lower grades with the program

considering ideas for a system of visits to vocational center area schools to acquaint them with the programs available to them

assisting in procedures for approaching and providing information for guidance counselors who help encourage students into the programs

Assisting in the establishment of criteria and qualifications necessary for students to apply for admission to the agricultural programs.

Providing information concerning desirable aptitudes, education and experience preferred for entry-level jobs and in the area of higher job level specialization requiring advanced training

Arranging plant and/or field visits for students and instructors (also parents in high school or elementary) that are interesting and educational, and which in some instances may serve as classroom instruction as relevant to work experience information

Providing specialized vocational literature to teachers, counselors, parents and students; such as occupational folders, brochures, pamphlets, etc.

Assisting the instructors in the formation of accurate, realistic specialized instructional projects for group and individualized instruction

Assisting in the development and obtaining of qualification, certification and licensing tests, including apprenticeship requirements to be used for initial employment of graduates

Participating in and helping to interpret surveys of local industry manpower needs, job availability, anticipated employment in the community and identification of employment areas

Assisting in placement of students in part- and full-time employment and advise in job placement of agricultural program students

Assisting with procedures for continuous evaluation of the programs and follow-up evaluation of graduates for program accountability which spotlights the value of the program or programs to the community and its employment needs

Educational Programs Pertaining to Career Information and Community-Parent Involvement

Evaluating and issuing supporting recommendations on budgetary requests, physical conditions, adequacy of equipment and supplies, laboratory shops, classrooms, etc.

Assisting in the development and periodic evaluation of course content to assure its being up-to-date in meeting the changing skill and knowledge needs of the community, and employment area for industry and business

Obtaining needed school equipment and supplies on loan, as gifts, or at special prices

Assisting in the establishment of standards of proficiency to be met by students and helping with job analysis and task analysis in specialized areas

Assisting in the development of school procedures concerning the kinds and volume of production work or "live jobs" to be produced by students so that this work will be of instructional value in the educational program

Establishing and helping to maintain a library of specialized visual aids, magazines, and books concerning industry and business in conjunction with the school library

Assisting in the development of special educational and training programs for disadvantaged and handicapped students conducted with funds made available by the Manpower Development and Training Act, the Economic Opportunity Act, etc., in accordance with the needs of the community and representatives of the administrative agency

Assisting in the development of evening school skill improvement and technical courses for employed personnel on the continuing adult level

Assisting in the development of on-the-job training related courses, in accordance with recommendations of local representatives and their specialized requirements

Arranging field trip visits for teachers to upgrade their teaching background in particular occupational areas

Providing, whenever possible, training resources, i.e., raw materials, finished products, equipment, charts, posters, etc., for exhibit and instructional purposes in classrooms and shops

Assisting in making cost studies for specialized programs and courses

Assisting in establishing sequence of courses for proper student development in order that graduates will have proper training in job cluster areas to compete in the job market

Seeking the cooperation, when needed, from other agencies for career education

Public Relations

Supporting Agricultural Education in its direct relationship to the activities of local and state school officials, boards and legislative groups

Helping to obtain speakers to address trade and civic groups, school banquets and assembly programs which concern the development of agricultural programs

Assisting in arranging for publicity subjects to school review, by using their contacts with news media - such as newspapers, trade magazines, radio and television stations - that would not otherwise be available to the school

Participating in radio and T.V. programs designed to sell Agricultural Education to the public

Participating in an "open house" for students, parents and other adults in the community

Inviting teachers, counselors, administrators and students to visit various farms and businesses

Advising employees and their families concerning school programs by posting information on bulletin boards, news stories in company publications and enclosures in pay envelopes with approval of top management

Assisting through donations and help to arrange for funds to advertise and advance specific school programs

Supporting through attendance educational workshops and conferences that advance Agricultural Education

Assisting in evaluating the public relations policies and actions of the school in respect to the community and the overall agricultural programs

Advisory Council Operations

Assisting in setting up and implementing a set of rules and bylaws to insure an active permanent advisory council

Support through regular attendance at meetings, and encourage total attendance of fellow members, to insure a well-represented and effective council

Student Recognition

Providing scholarships and other financial assistance for outstanding graduates who wish to continue their Agricultural Educational training

Providing recognition through prizes, awards and publicity for outstanding students, as approved by appropriate regulatory agencies

Providing recognition for outstanding leadership, and encouraging greater involvement

School Representative

Responsibilities to the Advisory Council

Cooperate and work closely with the Council

Help the Council Chairman to:

formulate the agenda for each meeting

provide advance notices and follow-up communications for each meeting

arrange for and aid the Secretary in writing the minutes of each meeting and disseminate to all members

keep attendance records

notify and communicate with school officials in regard to meetings

Be prepared to offer clear explanations, from the school viewpoint, of any question to come before the ADVISORY COUNCIL or agree to obtain the answer by the next meeting

Arrange for the facilities and equipment of the school to be used by the Council

Help provide needed research and information needed for Council activity

Prepare special reports as requested by the Council

Attend all meetings and establish a personal relationship with all members

Involve the ADVISORY COUNCIL at the inception of a program or consideration of change in curriculum

Help make the Council a continuing activity even after the program is successful

Aid in school approved public relations projects from the Council, releases to media, etc.

Arrange for proper recognition of Council members and their efforts

Advisory Council Chairman

What Do You Do?

The chairman is a highly important person to an ADVISORY COUNCIL. How he operates will often make the difference whether or not the COUNCIL is effective.

He Is Responsible For

Working with the school representative and Council members in setting meeting dates

Being the "driving force" behind planning the functions of the Council and working with the school on an acceptable agenda

Presiding at all Council meetings

Insuring a good personal relationship with all Council members

Working with the school representative on needed information and necessary follow up of Council activities and reports

Council meetings should begin and be concluded on time and conducted without adhering to strict rules of order. The Chairman should provide leadership and give each member an opportunity to express his viewpoint. Firmness and fairness is expected of the chairman. Also another duty is to keep well informed on the progress of the educational program for which the Council was formed.

How The Chairman Operates

Open and close the meeting on time

Review and present all pertinent information

Obtain the views of each member on each item on the agenda

Maintain all discussion to the subject matter at hand

Summarize often and obtain general agreement by group decision

Make sure all Council recommendations are recorded properly in the minutes

Make plans for the next meeting

SAMPLE

Examples of
some activities carried out by various Advisory Councils

Advisory Council's Activities
September to June

(Note: All Activities Must Be "Tailored" To Meet The Needs Of Each Community)

Advisory Council Members (as a group) came to school to "welcome" students into program

Council formed a "Speaker's Bureau." Makes available speakers on career topics of importance to students

Helped to revise form for students to evaluate their training stations

Send a "Thank You" letter to all cooperating employers in training stations, including a copy of rules and regulations for participating students

Attended area, state, and national FFA conferences

Presented a panel discussion to area teacher-coordinator conference

Secured interest and space for a feature story in local newspaper, assisted in its preparation

Arranged for "Student of the Month" for occupational areas publicity in Chamber of Commerce monthly paper to all members

Presented a program on certain careers before civic clubs

Secured radio editorial on certain educational career programs

Arranged for a Career Foundation with specific objectives and made contributions to fund

Members spoke with many students on-the-job to determine viewpoint and adequacy of training

Helped formulate the first award program to cooperating employers on training stations

Facilitated a special mailing of explanatory letters to all community businesses and industries on the school vocational cooperative education program

Participated in special programs on "Careers" before entire student body

Arranged for "Outstanding Student of the Year" award winners to be guests to Annual Chamber of Commerce Banquet, Lions Club Dinner and other interested community service clubs

Arranged for special newspaper coverage for all award winners and the Annual Employer-Employee Banquet

Secured teaching materials and equipment for classroom

Developed set of forms to be used in selecting outstanding student for the year

Secured promotional budget from local Chamber of Commerce of $350.00 with promise of increase

Held one or more meetings on total evaluation of the programs

Conducted a summer project "Development of new training stations"

Appendix D

Sample Agenda

Voc. Ag. Advisory Council
Wednesday, April 15

7:30 p.m.	Meeting called to order	Chairman
	Roll Call	Secretary
	Minutes of Last Meeting	Secretary
	Review of Agenda	Chairman
	Report of the Sub-Committee on Safety Practices Observed in the School Shop and OJT Center	Jim Henslick
	Discussion of report and recommendations	
	Additional Tools and Equipment Needed: Report on status of equipment and tools on hand	Jim Polston, Instr.
	Discussion of report and recommendations	
	Plans for Class Carpentry Project, 1973-1974 School Year: Report of Tentative Plans	Earl Haggard, Prin.
	Discussion and Recommendations	
	Other business	
10:00 p.m.	Adjournment	
	Refreshments	

Appendix E

Examples of items for Consideration by the Committee

July:

Constitution and by-laws
Screening training stations
Screening of students and placement of students
Listing training standards for training station
Develop training agreements
Determining publicity to be released

August:

Suggestions on wages and hours
Review course of study and reference materials
Determine what experiences are needed on the job
Consider policies on teacher supervision

September:

Decide on publicity to be released
Consider special problems that have developed

November:

Set up qualifications for special awards

February:

Determine award recipients and determine any special awards

May:

Evaluation of the program
Establishing graduates in full-time jobs

Appendix F

IF YOU WANT ME TO SERVE ON A SCHOOL ADVISORY COMMITTEE[1]

Mr. Educator:

I am pleased you have asked me to serve as an industry member of an advisory committee to our school system. I shall be delighted to accept your invitation - if you can assure me that I will be involved in an activity which is going to make some worthwhile and important contribution to the education of our youth. I want to be proud enough of the committee's work so that I may brag a little to my family, friends and associates that I was selected to participate - as you, yourself, stated - "because of my reputation as an outstanding member" of the field in which I am earning my living, "as well as for my interest in and understanding of the field of education."

To support my feelings about the importance of my service, I would like to have a letter appointing me on the committee signed by the highest possible school official. The letter should include some biographical information on the chairman and other members of the committee and also tell me exactly what is expected of me as a committee member in the way of advice, assistance, cooperation, money and time. Please note that if you tell me the committee will meet only two or three times a year, I will know that we really aren't going to do anything worthwhile!

On the other hand, if you seriously want help from the committee to improve our educational system, I need to be sure that I will be provided, initially and on a continuing basis, with information concerning educational developments within the school system, as well as at the state and national levels; be invited occasionally to attend local, state and national conventions of educators (you will be surprised by how many I will attend at my own or my company's expense); and that I will occasionally receive a special invitation to attend a school function, a board of education meeting, a state board meeting. I would also like to be kept informed of special studies affecting the educational program of my school system, and if possible, receive copies.

In effect, what I am saying is that if you want me to advise you, I will feel much more comfortable if I know something about you and your environment. And while I am learning, hopefully I am becoming identified with you, the school, and the problems of the educational system. If you can get me to this point you can be assured of my active participation in the school program and on the committee. And beyond offering advice, I will actually cooperate with you to help you achieve your program goals.

How? In every way possible! I would be glad to help raise money for a scholarship fund; to help obtain needed school equipment on loan, as a gift, at special discount; to contribute expendable supplies, instructional and guidance materials, to provide work/study experiences; to employ graduates, to help counsel students; to assist teachers in enriching and expanding their instructional activities; and other services you may request. You name it! What I am really asking is that you, the professional educator, provide me, the interested layman, with counsel and leadership for my committee responsibilities.

[1]National Advisory Council on Vocational Education, Washington, D.C., July 1974 (Mimeo).

I know there will be times when you will ask the committee for something you consider important that for some good reason we will not be able to provide. But we won't just be negative when this happens. We will tell you our problem and try to work things out with you. In the process, we will both learn more about industry and education, and together prove that industry-education cooperation can be a viable way of life for citizens and school people.

Sometimes I might want to do too much and try to get involved in administration. If I do, just point out that the best way I can help you is to give you advice and cooperation and leave the details of day-by-day school operations to you. In reality, I don't even have time to handle all my OWN day-to-day administrative problems, much less yours! But remember - as businessmen, we committee members are problem oriented and if you tell us about your problems we can help you with them, even if it takes time from our personal or business affairs. After all, we expected to spend time with you when we accepted service on the committee.

I would like to be welcomed in the schools as a friend and supporter - not seen as a meddlesome interloper. Naturally there are certain school regulations which I should observe when visiting, and you should make them clear to me. But if I occasionally drop in for a visit, give me a few minutes of your time. Your courtesy will be well repaid. I wouldn't come if I weren't interested!

I would like to know what other schools and school systems are doing about the problems you present to my committee. I want to feel there is some linkage between our school system and others in the area. I would like to know what the private schools are doing and what MDTA educational and training programs are available in the community. I want to understand the relationships which exist between these programs, the State Employment Service, "war-on-poverty" programs, correctional institution training programs and any others that will be providing man-power for industry. I want to know the whole picture, and even get a chance to visit these other educational programs. Perhaps our advisory committees ought to meet together once or twice a year. I want to know about these other programs so that I will not have the nagging feeling that I am being "used" to support one program in opposition to another. I want to feel that I am helping to improve "MY" school's contribution to the total community effort - as a taxpayer, as an employer and as an interested citizen concerned with and involved in improving educational and manpower development programs in my community.

I would like to meet, more than on a token once-a-year basis, with the students in the school or program my committee was organized to serve. I want the students to know my committee exists. In the final analysis, our efforts are supposed to be directed at improving the education and training of students. I want them to tell me to what extent we are succeeding. As a matter of fact, I would like to have each graduating class elect one of its members to serve as an ex-officio member on our committee to tell us, in the first year after graduating, how relevant school really is in terms of real jobs.

I would like some expression of appreciation for my volunteered services and contributions. If this committee is as important as you tell me it is, give it and its members some concrete form of recognition. For example, if I donate a piece of equipment, put my nameplate on it. Send me a framed certificate of appreciation for my services. Hold a special annual event to recognize the services of all advisory committee members. Include our names in the school catalog and annual reports. We all like to see our names in print! Besides, when prospective students, their parents and others see that your programs, as described in the catalog, are receiving advice and assistance from industry people, the programs will gain in stature and prestige. In addition, my company and the industry I represent will be more than ever committed to support you.

When you ask me to attend a committee meeting, I want to know beforehand what will be on the agenda. I will want a brief background statement of the problems to be discussed and several possible approaches to the solution of each. Give me at least two weeks' notice of the meeting date. Make it at a convenient time and preferably at a school. And don't hesitate to remind me about it by letter or a phone call.

I want the meeting to be conducted informally and not to get tied up in parliamentary rules of order. I will want the meeting to be held within reasonable time limits. Don't let it drag on and on. I am used to crisp, businesslike procedures. I will want something to happen as a result of the meeting. I will want to know, as soon after the meeting is over as possible, what did and will happen as a result of our advice and services. I don't want to be asked to attend a meeting to approve something after it has already happened. If I find out I am being used that way, don't be surprised when I become your critic instead of your advisor!

I know I am asking a great deal of you. But I am willing to give a great deal in return. And the more you get from the committee, the better your program will be. The same is true for us, of course. All the committee members, as well as the industries we represent, will be benefitted by having a continuing source of qualified man-power available and by getting a good return from our educational tax dollars. All kinds of benefits will emerge if the committee is effectively used.

In the final analysis, this is exactly what I want - effective utilization of my expertise, my knowledge and my interest in serving one of the most important components of my community - my schools and their students. If you are prepared to tell me how, when and where, I will do my best to help you and will appreciate the chance to serve - particularly if you get me involved in an activity in which I have some special interest. This means, of course, you and I will have to discuss what my special interests are vis-a-vis education and young people.

If you think I speak for myself alone, you are very much mistaken. Most industry representatives who agree to serve on school advisory committees feel as I do. However, too often and in too many situations, their expectations have not materialized.

Why? Because in our experience, we have found that too few educators and school administrators understand what motivates industry people to accept service on a school advisory committee. Or, if they do understand, they have not been able to provide the leadership, time and effort to effectively utilize the committees. If you cannot provide the staff time needed to allow for the full range of interests and desires of your committee to serve the school program, you will be better advised not to establish the committee in the first place. A poorly used committee is worse than no committee at all - you would find that you had created your own Frankenstein. Disgrunted members of poorly used committees frequently become the most active critics of school officials and public education.

Well, that seems to cover everything I had to say. It's up to you now to decide whether you want me to serve on your committee. I look forward to hearing from you.

Sincerely,

/s/ _____

Samuel M. Burt, a consultant to the National Advisory Council, wrote this article as an open letter. Written as a businessman's reply to an invitation to serve on a school advisory committee, the letter tells the educational community what to expect from a businessman and what a businessman expects from the educational community.

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